APPLIED NUTRITION

HAROLD F. HAWKINS, D. D. S.

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By

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DEDICATED

TO

THE MEMBERS OF THE

DENTAL PROFESSION WHO HAVE

PREVENTIVE DENTISTRY AS AN IDEAL

FOREWORD

Practically all the present works on nutrition are concerned more with the theory and body requirements of the essential food factors than with the technique or practical application of this knowledge to different pathological states with a view to correcting faulty body chemistry.

Covering a period of fourteen years, over five thousand individual cases have been studied with the aid of biochemical tests. The corrections have been accomplished principally with food, supplemented by a small percentage of vitamin concentrates. No drugs in the strict sense of the word have been used.

The findings and conclusions reported in this volume are the result of direct studies on human beings—not on laboratory animals. Thousands of individuals place themselves on diet programs of such a character as to produce abnormal and extreme deviations from normal in their body chemistry. Careful study of these cases, noting the changes resulting as their chemistry returns to normal, has formed the basis for the conclusions drawn.

In studying body chemistry and developing a nutritional system directly on human subjects, great care was used not to draw conclusions from a few cases because man cannot be kept under such strict control as laboratory animals. However, this objection is eliminated when the average of many cases forms the basis of the final premises. There are some distinct advantages in using human subjects since the results obtained from animal experimentation cannot be transferred to man without some modification. The material presented in this volume is made up of the data and deductions resulting from this study of human beings exclusively, and forms the basis for a new approach in diet regulation.

This book is a record of the author's techniques and methods of procedure in establishing normal and in correcting faulty body chemistry. All available sources have been drawn upon in securing suitable techniques. Standard methods have been modified when necessary to make them more suitable for the type of material being tested. Where no techniques seemed to exist an effort has been made to create methods suitable for the task at hand.

The thought has been to run the fewest number of tests with the least amount of material that would yield the maximum amount of information.

This system or method of approach has been a growth over the years in which many have made contributions. Acknowledgement is given to the following for their constructive help: W. W. Hendricks, Norman R. Hills, Helen M. James, Evelyn Putnam, Henry H. Morgan, Houston Thomas and also Roed Zimmerer, my assistant, who has rendered effective help with the manuscript.

My colleagues have urged for many years that these methods and techniques which have proven to be so effective in the control of dental caries and pyorrhea, be made available in book form. With the presentation of this volume goes the hope that many may find in it the answer to some of their earnest inquiries. A serious effort has been made in this attempt to establish "what is normal" for a few of the essential food factors. These can be enlarged and built upon as the years go by.

—The Author.

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APPLIED NUTRITION

CHAPTER I

THE BASIC FACTORS UNDERLYING DENTAL CARIES

There are many dentists and physicians who are honestly confused as to the cause of Dental Caries. This is due in part to the multiplicity of research data. There also has been an over-emphasis on some factors that are necessary for general health and well being, but while fundamental to good nutrition, are not of enough importance to be considered as essential factors to our problem or to an understanding of it. To introduce these distantly related factors into a discussion is to muddy or confuse the issue and makes it impossible for those not intimately engaged in research to grasp the essential factors of caries control.

It is the purpose of this discussion to tell briefly, in simple language free from complex research data, the story of how dental caries occurs.

The tooth is composed essentially of lime salts. The enamel is the most important tooth structure in a consideration of caries, for if there is no gum recession the enamel has to be penetrated before the dentin can become involved. The enamel is composed of almost 90% tricalcium phosphate and about 10% calcium carbonate with traces of magnesium, fluorine, etc. The amount of organic matter is probably less than 2%.

The fact that decay occurs readily in non-vital teeth as well as those which are vital shows that internal circulatory influences are not of paramount importance.

The only way the enamel can be injured physically is by chipping, abrasion, and by chemical action. We know that chipping is not decay. Abrasion may intensify the destruction of partially decayed teeth but is not caries. Therefore, the condition we call decay is essentially a chemical process.

Having reduced decay to a chemical process or dissolution, we are ready to consider what the inciting chemical factor may be. The environment surrounding teeth in the mouth is essentially saliva, food residue and micro-organisms. It has been proved by many research studies that pure saliva, no matter how acid or alkaline, can never cause caries-like lesions. Food in the form of carbohydrates mixed with saliva containing the micro-organisms found in the mouth can, in a few weeks, cause marked decalcification of the tooth. Studies on the inciting factor have reduced it to an organic acid, possibly lactic, formed by the action of micro-organisms on carbohydrate food.

The acid-fermentation theory of W. D. Miller as the primary or inciting cause of dental caries has been verified by so many workers that it can be accepted as an established fact. Fermentation goes on to some degree in all mouths irrespective of whether they are immune to caries or subject to it. In one individual caries results on account of it, while in another, no tooth injury or destruction takes place. Practically all the confusion that has occurred is due to our efforts to explain how a person can remain immune to dental decay in the face of these organic acids which we know have an active affinity for the tooth structure.

We have shown that dental decay is a chemical process. Let us see if there is not a simple explanation of immunity that can be given which is harmonious with the laws of chemistry and still in accord with good research findings. Here we have an acid capable of combining with either the calcium phosphate or calcium carbonate of the enamel. How can the chemical activity of this acid be destroyed and in so doing save the tooth? Chemistry holds that there are only two ways in which this can be accomplished: First, by chemical union with another substance that has basic properties; or second, by dilution to a point where the acid is inactive chemically. Our inquiry of necessity must be directed into these channels.

Let us examine the saliva from immune mouths for any basic subsances that could neutralize an acid. It has been shown that there are two or possibly three such factors: (1) The soluble alkaline salts of potassium, sodium and magnesium. (2) The more or less insoluble salts of calcium that are principally in fine suspension or in the colloidal state. (3) A small amount of mucin which is a glyco-protein possessing some, but very slight, neutralizing capacity.

It has been demonstrated that the immune to decay possess a fairly high neutralizing capacity or buffer value. Studies on the saliva of those with active decay show very poor buffer value or neutralizing capacity. As mentioned above, we have another way, harmonious with good chemistry, of reducing the activity of an acid. That is by dilution. If any acid is sufficiently diluted with water a point will be reached where the acid is too weak to act chemically on calcium salts. The author has conducted a study on this point and has found that 74% of those with active caries seem to have a deficiency in the amount of saliva while only about 23% of the immune to caries could be so rated. This seems to be harmonious with the experiences of most dentists that a dry mouth is a contributing factor to caries.

We now have shown that the acids of fermentation are responsible for dental decay or the destruction of the tooth. The saliva of the immune, however, possesses sufficient neutralizing capacity to destroy the acid and protect the teeth. This is not true of the susceptible who lack sufficient neutralizing capacity or buffer value. The amount of saliva, while of considerable value as a protective agent, is not so important as the neutralizing capacity or buffer value which consistently runs parallel with the state of immunity or susceptibility.

Now that we have established the inciting cause of caries and have discussed the major protective factors, which are the neutralizing action of the alkaline salts of the saliva and the diluting action of a copious flow of saliva, it would seem that we have explained the full process of dental decay. That is not the case as we still have one more important factor to be considered.

It has been known for some time that a high starch diet, principally of refined cereal starch, is a liability; also a high candy or sugar intake is conducive to dental decay. In what way does this seem to operate?

Just recently a two year study has been completed by the author that seems to explain why a carbohydrate diet is detrimental as well as why the acidogenic bacteria which are responsible for the production of acid from carbohydrates seem to rise or fall as a person becomes susceptible or immune to decay. I refer to the value of ptyalin which is the starch-splitting ferment of the saliva. This study shows that 66% of those with active decay are definitely short in ptyalin, while those who are immune to decay show a shortage of only 24% in this starch-splitting enzyme.

This ferment seems to operate by breaking down the cereal starch to sugar which is soluble and can be washed away readily by the saliva. If the adhering starch is not so broken down by the ptyalin it becomes a wonderful culture media for the acidogenic bacteria that convert the starch to an acid which in turn can attack the teeth if the buffer value of the saliva is low. It might be asked how a high sugar diet contributes to decay inasmuch as it is soluble and should be washed away by the saliva. The level of ptyalin in the saliva is dependent upon two factors: (1) the amount of Vitamin B in the diet which builds up or increases ptyalin, and (2) the percentage of carbohydrates, either starch or sugar, which tears it down. Dr. Price has shown that when a diet contains no refined starch or carbohydrates and the diet is otherwise in good balance the incident of caries is low. When the diet contains a high percentage of refined cereals and sugars coupled with a fairly well balanced diet, the incident of caries is much higher. It must be remembered that unrefined cereals are a valuable source of Vitamin B while the highly refined product is almost devoid of this vitamin.

It is important that Vitamin B be adequate and in proportion to the amount of carbohydrates consumed, otherwise fermentation in the mouth cannot be prevented or kept low. Practically all diets used by civilized man contain a generous intake of either starch or sugar and usually both. A generous ptyalin level is therefore an important protective mechanism and definitely related to the incident of decay.

We now are ready to summarize the basic factors underlying dental caries.

1. The inciting factors in caries are the acids of fermentation which are capable of injuring the tooth unless neutralized or rendered inactive.

2. The soluble and insoluble alkaline salts of the saliva that constitute the principal buffer substances are capable of neutralizing the acids caused by fermentation and in so doing protect the teeth.

3. The amount or quantity of saliva present in the mouth is a protective factor and is capable of diluting the acids of fermentation as well as helping to wash away food residue.

4. The ptyalin level of the saliva converts the starch residue to sugar and in so doing helps to prevent fermentation. Hence, the absence of a normal ptyalin level is a contributing factor to caries in any diet where starches are being consumed.

The above basic factors are paramount for an understanding of how dental caries occurs. It goes without saying that if the above factors are out of balance or below normal they will have to be placed in their normal relationship if caries is to be controlled or prevented. It may call for a change in the level of the minerals, vitamins, digestive and endocrine secretions, or a complete transformation of the mental attitude of the patient.

It is important to make up your mind as to what dental caries is before you attempt to treat it. Then endeavor to influence the faulty chemistry in a rational way by a well planned, definite procedure. The day is past for scatter-gun methods of control in which a host of products is recommended. This procedure too often ends in failure.

Success in the control of caries can be obtained only by a thorough understanding of the factors involved, the particular deviations in each case, and the most effective means for their correction.

CHAPTER

II

WHAT IS PYORRHEA?

The word pyorrhea has been associated with a definite pathological syndrome in the minds of the dental profession as well as the general public. There are many other words which are more descriptive of this condition, but none so well known or able to convey the subject under discussion as the word "pyorrhea." As additional research has expanded our knowledge of what pyorrhea really is, many new words have been coined. Today, therefore, we are confronted with a considerable list of common and uncommon names assigned to this pathological state.

Until that time arrives when we are more or less agreed on what pyorrhea really is, it seems quite futile to attempt to select a descriptive name for a condition the etiology of which we do not know—or at best, on which we hold so many divergent opinions.

In presenting a discussion of "What is Pyorrhea?" an effort will be made to confine the discussion to the underlying or systemic factors rather than to a description of the local picture or to a dissertation on the response of the oral tissues to instrumentation or medication.

If the integrity of the alveolar process and the mucous membrane surrounding the teeth can be maintained there can be no pyorrhea. The term "pyorrhea" should be applied only when the bony process surrounding the teeth is destroyed either by bacteria from soft tissue pockets or by a metabolic disturbance of a definite character. It should be borne in mind that altho bacteria play a very active part in the destruction of the alveolar process in a high percentage of pyorrhea cases, yet a very sizable percentage of cases is purely metabolic in character and in these cases bacteria and tissue pockets play absolutely no part. For that reason it would seem unwise to use the term "pyorrhea" for any case showing slight tissue pockets without definite bone destruction.

As the clinical picture of pyorrhea is so well known it seems a waste of effort to attempt a serious description.

In approaching a discussion of pyorrhea it might be wise to discuss first, (a) the underlying causes responsible for soft tissue pocket formation; and secondly, (b) the causes leading to the disintegration of the alveolar process.

(a) The tone of the mucous membranes of the oral cavity can be maintained only in a state of optimum health when the individual cells are adequately nourished, each receiving its quota of minerals, vitamins and probably hormones. Abnormal stress due to physical forces or bacterial products tends to work against a normal tone. Any failure in the removal of waste products or in the free flow of nourishment to the cells as in a state of congestion is a distinct liability.

When there is a loss of resistance or tone of the mucous membranes the tissues are open to bacterial attacks and sooner or later certain areas receiving these major stresses will give way and soft tissue pockets develop.

It might be profitable to list the factors essential to good or optimum soft tissue tone.

1. Adequate minerals, vitamins and hormones to the area. The diet must be optimum and well balanced.

2. The reaction must be normal—not too acid or alkaline. This is brought about by a suitable buffer value in the blood. Proper oxidation and the rapid removal of waste products is essential.

3. A low residue diet program is necessary so bacteria and micro-organisms will not find too fertile a field for multiplication.

4. Suitable gum massage is essential as nature seems to be dependent upon some physical force to increase circulation to this area. This means more and better nutrition to the part and removal of waste products from it. The use of tough or fibrous foods which have a scouring action tends to remove food particles and bacteria and improves the circulation, giving a general toning up effect to the tissues. The use of the tooth brush is valuable, but most of the massage should come from food.

5. Any dental restorations should be made as anatomical in form as possible. This usually makes for self-cleansing and permits considerable massage to the tissues. If possible, a restoration should not create areas where food can collect.

6. The general health of an individual is a factor in good gum tone. It is inconsistent to expect good gum tone when the general health is poor or very much below average.

7. The use of irritating mouth washes is to be avoided. While antiseptic mouth washes may be of some value for acute oral infections, their value in chronic infections over a prolonged

period of time is open to considerable question. The normal saliva has germicidal properties and usually is able to do a more effective piece of work than chemical agents unless the agent is specific for the particular organism causing the infection.

Good gum tone is essential in the prevention of tissue pockets. Inasmuch as these pockets are caused by micro-organisms the importance of good tone to the oral mucous membrane cannot be over-estimated. To secure healthy, resistant mucous membrane the tissue must be adequately nourished. This means a suitable diet. The saliva must be of the right composition and be copious in amount. The food must be of such physical character as to give good massage and to leave as little residue as possible which will tend to discourage a high mouth flora. If a firm, highly resistant mucous membrane can be maintained in all areas of the mouth, soft tissue pockets can not take place.

Most dentists call any soft tissue pockets in and around the teeth pyorrhea pockets. As we know more about the etiology of pyorrhea we probably will have to make some distinctions we do not make at present. To illustrate: If a faulty bridge or crown creates areas of food retention in a mouth that has been entirely free from pyorrhea and, due to the bacterial activity in these food retention areas, a tissue pocket develops under this fermenting mass, is that pyorrhea? Or should we use the word pyorrhea for a purely systemic condition that causes alveolar absorption and usually soft tissue pockets as a local manifestation? The etiology is quite different and it does not seem consistent to call a condition that has a purely local origin by the same name as one caused by a metabolic disturbance.

(b) This leads us, then, to the second part of our discussion. What causes the destruction or disintegration of the alveolar process? If we examine the chemistry of bone we will see that the inorganic part is made up roughly of 90% tricalcium phosphate and 10% calcium carbonate with traces of magnesium and fluorine. It will be seen from the above that calcium and phosphorus are of great importance. Blood, saliva and urine studies on several hundred pyorrhea cases believed to be active at the time the tests were run reveal three faulty relationships of the bone building elements.

Type 1. Calcium low and phosphorus usually very high.
Type 2. Calcium low and phosphorus very low.
Type 3. Calcium very high and phosphorus low.

The first type is the typical and usual form. The clinical picture is that of congested gums with many large soft tissue pockets with a tendency for calcium deposits above and below the gum margin and with a tendency for bleeding. Tests usually reveal a saliva that is actually acid or the alkalinity is depressed. The alveolar process shows a general loss of density with enlarged cancellous spaces. There is usually a general flattening of the alveolar crests with extensive pockets or bone destruction in the areas beneath the soft tissue pockets. Probably not less than 75% of cases are of this type.

The second type of our classification comprises a much smaller percentage of the general total. The clinical picture is very different from the typical or common form. The gum tone is usually very good with no congestion or bleeding. There are no tissue pockets that can be entered with an instrument or explorer without breaking tissue. There is no tendency for salivary deposits above or below the gum line. There may or may not be gum recession. The alveolar process presents a very different picture, however, as the destruction or absorption of the process may be very marked. There appears to be a general wasting away of the bony process, often to a degree that the teeth are extremely loose and may have to be extracted.

The third type is extremely uncommon—possibly not over

2% of all cases. The mouth picture usually shows considerable salivary deposit, but the gum tone is usually good with the possible exception of a slight irritation adjacent to the tartar areas. We do not expect soft tissue pockets, but the alveolar crests are usually flattened. The calcium is not being pulled out of the body by phosphorus as is the case of the first type, but possibly by some other acid radical like sulphur. Because this type is so uncommon it is not generally recognized. The constant use of chemical tests was the only way this very uncommon form of pyorrhea was detected and its chemistry identified.

For the actual chemical levels of the three types of pyorrhea see the chapter on "Dental Pathology."

By constantly checking the chemistry against the clinical picture on pyorrhea cases we have become convinced that true pyorrhea is principally a disturbance in the calcium-phosphorus balance. This faulty balance can give rise to either good or poor tone of the oral mucous membrane depending upon the particular balance; and further, this disturbed relationship causes faulty bone building and bone density with a tendency for absorption of the alveolar crests. Pocket formation in the soft tissue or alveolar process is usually caused by a lowered resistance of the part. While the levels of calcium and phosphorus play a major roll in pyorrhea, yet other factors, as poor assimilation, or elimination, or faulty oxidation, are important. The vitamins, especially vitamins A and C, are of great importance as they help control the tone of the mucous membrane.

In Type 1 cases the high phosphorus, which is an acid element, usually depresses the alkalinity of the saliva with a marked loss of tone making possible a bacterial invasion. This high phosphorus pulls calcium out of the body with a loss of density of the bony process. If the calcium leaves the body by way of the saliva, heavy seruminal or salivary calculi are left on the teeth. If calcium is lost by way of the urine the saliva may be so low in calcium that erosion or gingival caries may result.

In Type 2 cases the phosphorus is very low and as a result we usually have a very alkaline saliva which makes for a good tone of the mucous membranes. In this type of case the calcium is not mobilized on account of the low phosphorus. The alveolar process gradually decreases in density because either the quantity or assimilation of both calcium and phosphorus is such as to make the intake less than the outgo. There is a gradual wasting away of the process. Infections usually play little or no part in this syndrome and we do not find typical pocket formation in either the soft or hard tissues.

In Type 3 cases we have an apparent paradox. We have calcium being pulled out of the body on a low phosphorus level. It is true that phosphorus is the principal mobilizer of calcium, but we also must remember that a slight drop in alkalinity, no matter what the cause, will make calcium more soluble with the increased tendency for a loss. Any of the following factors will increase the loss of lime either through the urine or saliva. There may be a failure to oxidize organic acids like citric or malic due usually to a low hydrochloric acid or low basal rate. The intake of too much magnesium generally taken in the form of Milk of Magnesia will throw calcium out usually through the urine. Then we have sulphur—an acid element—that can mobilize calcium with a loss through saliva or urine. Sulphur may be assimilated in excess if too many eggs or mustard products are consumed.

The above discussion shows the importance of the calcium-phosphorus balance in a general consideration of pyorrhea. It must not be lost sight of that many other forces and factors have an important place in this syndrome, as gum massage, food residue, the general chemical and vitamin levels, as well as the glandular efficiency.

Advanced cases of pyorrhea are difficult to control especially Type 1 cases, as the amount of infection is usually so pronounced as to prevent bone regeneration. The alveolar density can be increased greatly in the uninfected areas and the progress of the infection greatly reduced or stopped. With the improved tone of the mucous membranes and alveolar process due to a normalization of the body chemistry, advanced pyorrhea cases of this type can be carried for many years beyond the expectancy for instrumentation methods.

In pure Type 2 cases of our classification where there is good gum tone and no tissue pockets or bone infection, good recalcification is to be expected if the bone matrix has not been seriously injured or destroyed.

The results obtained in Type 3 cases depend largely on the presence or absence of soft tissue pockets and whether the bone is actually infected. No bone regeneration can be expected to take place in the mouth or in any part of the body until infections are placed under control. The difficulty of maintaining asepsis in the oral cavity during the period of bone regeneration is an important reason for failure in pyorrhea therapy.

The logical attack on pyorrhea should be prevention rather than cure. The average case of pyorrhea takes many years to develop and because of this an opportunity is offered to do real preventive work. If the body chemistry could be checked at least once per year—or better, every six months—and the patient would follow the suggested program, a marked reduction in the incident of pyorrhea would follow. If the body chemistry can be controlled pyorrhea can be prevented.

CHAPTER

III

IMMUNITY TO DECAY AND ITS RELATIONSHIP TO DENTAL PATHOLOGY

A study of the composition of the saliva of the immune and carious showed that in the case of the immune to decay there was a highly alkaline saliva or a high calcium content and often both, while the saliva of those with extreme decay showed considerable acidity and a low calcium content.

If it be true that those who are permanently immune to decay maintain in their saliva at all times a concentration of alkaline salts and calcium sufficient to neutralize the acids of fermentation, then it would seem logical that the permanently immune to decay could be used to establish a safe limit beyond which caries would not result. We have established a line based upon the alkalinity and calcium content of the saliva which serves to divide those that are immune from those subject to caries.

Chart No. 1 shows about 140 persons who are immune to decay. No one in the tabulation ever had a cavity of decay, it is strictly a graph of immune individuals.

Every dot on the graph represents the reaction of an immune individual. It will be noted that most of these dots are on the alkaline side of neutral which is shown by a heavy vertical line. All dots on the acid side of neutral, some of which are quite acid, represent high calcium values. A diagonal line was established which represents borderline cases. This line can be used as a dividing line between immunity and decay. Several thousand salivas have been tested against this line with the result that it seems to be a fairly accurate dividing line between immunity and active caries.

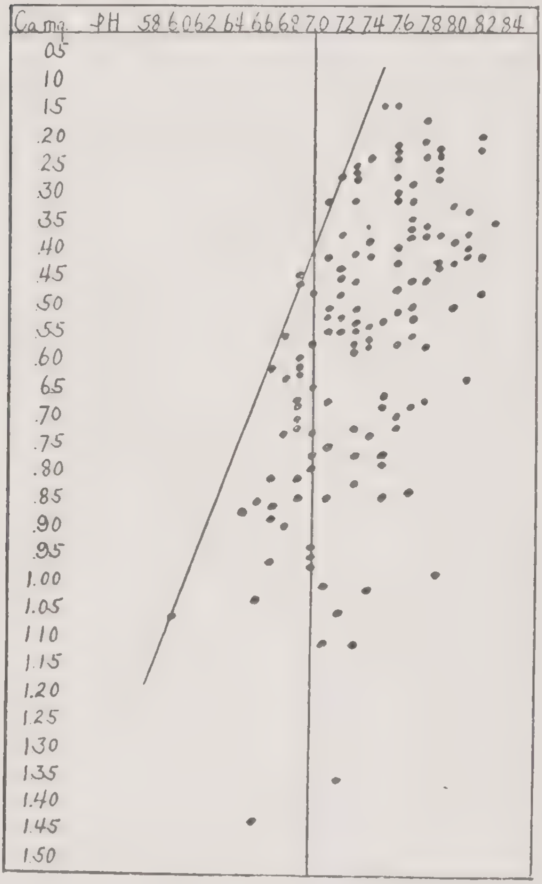


Chart I
Immune to Decay

The reactions of the saliva were measured by the colorimetric hydrogen ion test. A modified colorimetric method was selected in preference to the electrometric method because it was found possible to measure the buffer value of the saliva on a small sample. By permitting the indicator to remain in contact with the salivary sample for about one hour, a slight or marked change took place in the reaction. The rise was generally toward greater alkalinity and at the expiration of this period usually reached an end point. We believe that the final reading at the end of an hour is very close to the true neutralizing value of the saliva.

Chart No. II shows the record of those who are suffering active decay. All on this tabulation had many apparently active cavities. The big majority are on the acid side of the diagonal line and represent low calcium values. A few were on the immune side of our line at the time of the test. Our records show that those remaining on the immune side for any length of time have their cavities turn dark and develop what is known as "arrested caries."

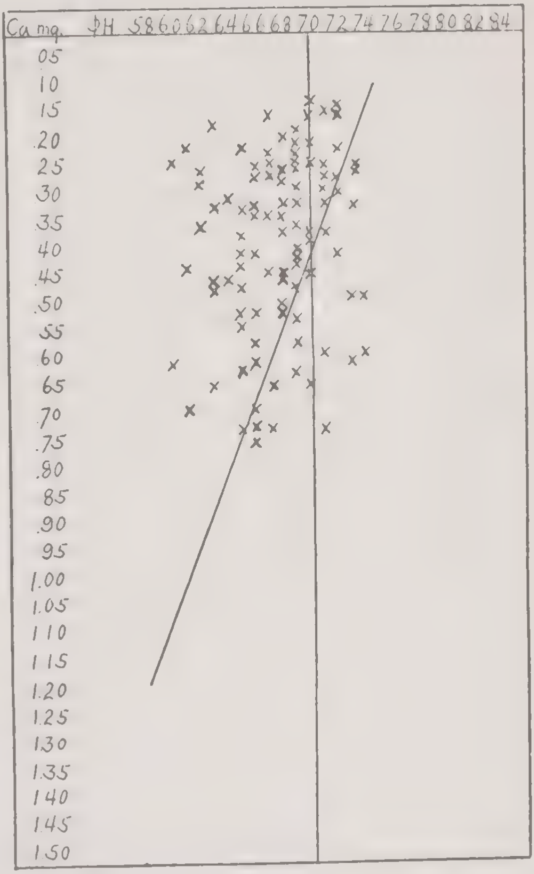


Chart II
Active Decay

Chart No. III shows erosion and gingival decay—the latter known as Class V Cavities, Black's terminology. These cases tend to parallel the diagonal line. The saliva is not poor enough to permit active decay or good enough to secure immunity. Erosion cases lie to the acid side of the diagonal line and represent high calcium values. These areas are always highly polished and often accompanied by considerable tissue recession. Gingival decay or Class V cases are acid or slightly alkaline with low calcium; the areas are not highly polished and there is no tissue recession. There is a close relationship between erosion and systemic pyorrhea and an equally close relationship between gingival decay and the other forms of caries. There is no doubt that tooth brush habits and gritty dental pastes play an important part in removing decalcified enamel with a resultant polished surface.

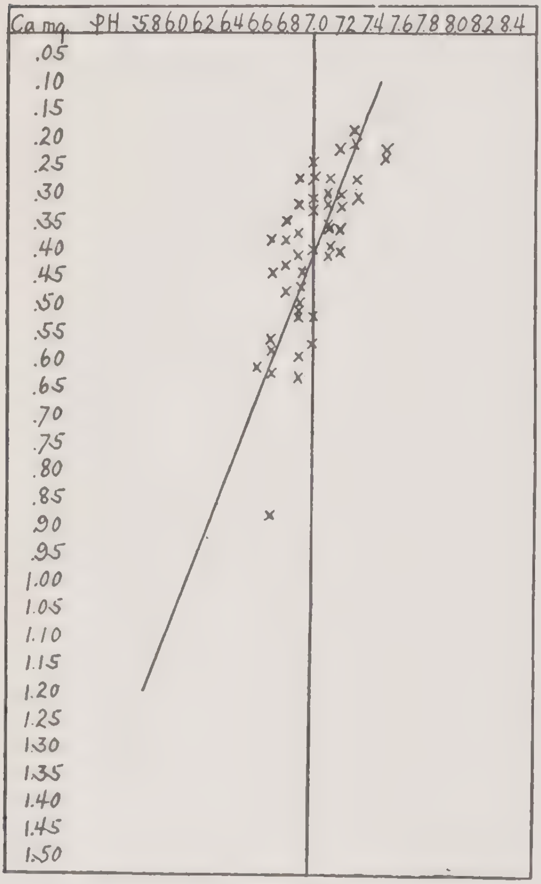


CHART III
Erosion and Class V Cavities

Chart No. IV is a graphical representation of the important facts brought out in the foregoing charts. It shows areas of Active Decay, Erosion, Gingival Decay and Immunity.

The dotted line shown on this graph calls for some explanation. All points on this dotted line have the same degree of immunity as to caries. The small circle shown represents the ideal immunity and position for a child as to buffer pH and calcium. If the buffer pH is made to vary and the calcium assimilation is kept at a constant, the position of the small circle will rise or fall in parallel to the dotted line. For each change in pH of .1 there will be an increase or decrease of 0.067 milligrams of calcium depending upon the direction of the change. On an increase in alkalinity the calcium will fall.

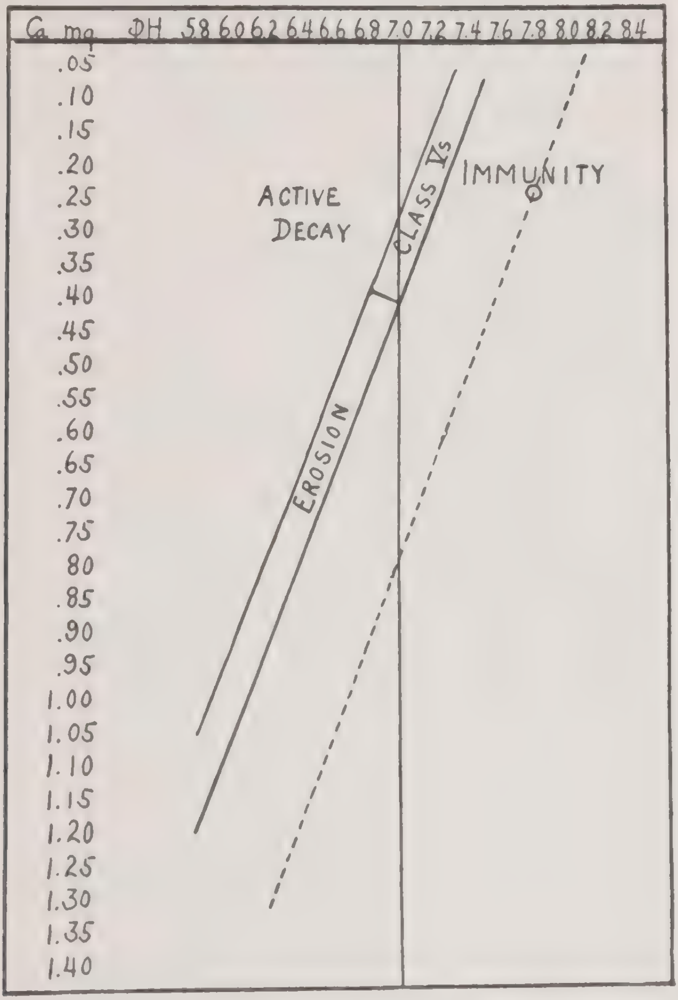


Chart IV

When the buffer pH is made more acid the calcium will rise. Because of this fact it is possible to tell whether an individual's calcium is normal as to amount irrespective of the buffer pH. In other words, if the buffer pH and calcium of the saliva in question can be shown to be on the dotted line, the calcium level of the individual is normal.

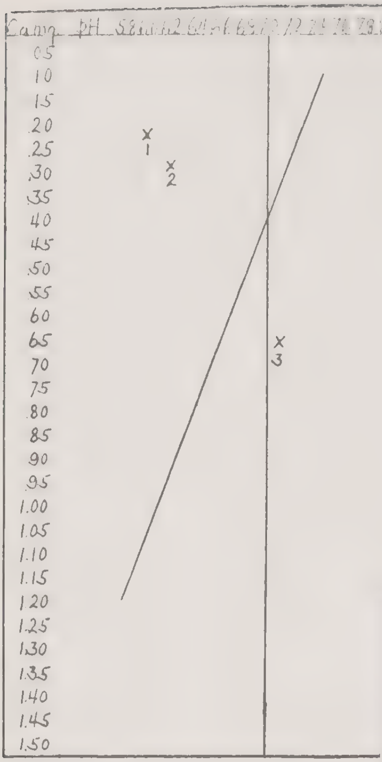


CHART V

Effect of a well balanced diet on active decay case.

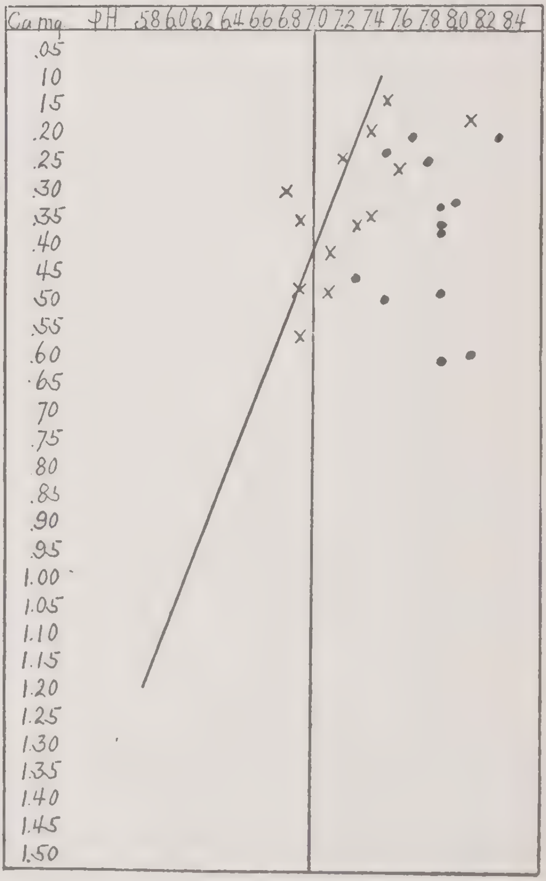


CHART VI

Effect of Orange Juice and Cod Liver Oil on a group of children.

The practical application of this knowledge as applied to individual cases will be shown as follows:

Chart No. V. W.M.W. An individual with active decay living on a very high cereal diet, potatoes were substituted for cereal foods and more vegetables were added. In the ten weeks covered by these tests, he passed from a condition of pronounced acidosis accompanied by active decay to a condition of slight alkalinity and immunity to caries.

Chart No. VI. The reactions of a group of children placed them too close to our diagonal line for safety. A half cup of orange juice and a small amount of Cod Liver Oil were fed each day for a month. No other change was made in the diet. At the end of this time the saliva was rechecked. The original tests are shown in crosses, the final tests in dots. A marked improvement in the alkalinity and percentage of calcium is shown.

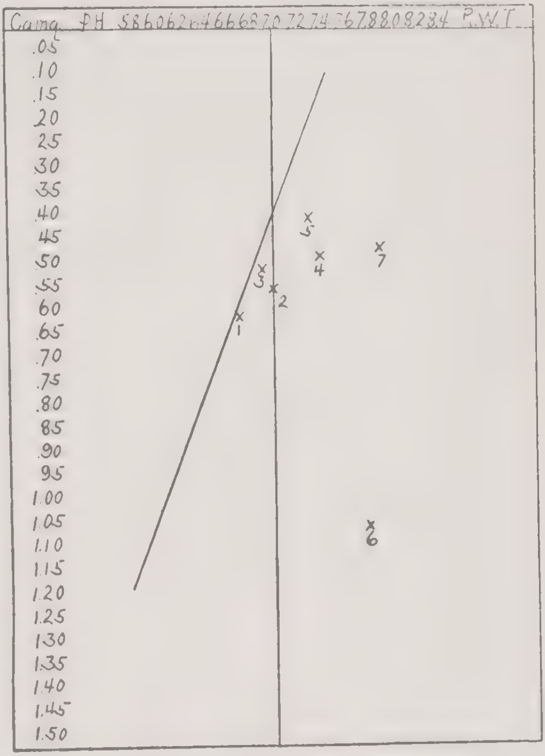


CHART VII
Effect of alkaline diet on erosion case.

Chart No. VII. R.W.T. Effect is shown of a well balanced diet on an erosion case covering a period of six months. The tests are numbered in the order in which they were taken. As will be seen the progress was not uniform due to a failure at times to maintain the diet, but the final tests are very favorable and resulted in a good margin of immunity.

Chart No. VIII. L.W.N. Shows an individual on a high cereal, low vegetable diet with active decay and pronounced nutritional anemia. The progress was slow on account of the poor appetite and low phys-

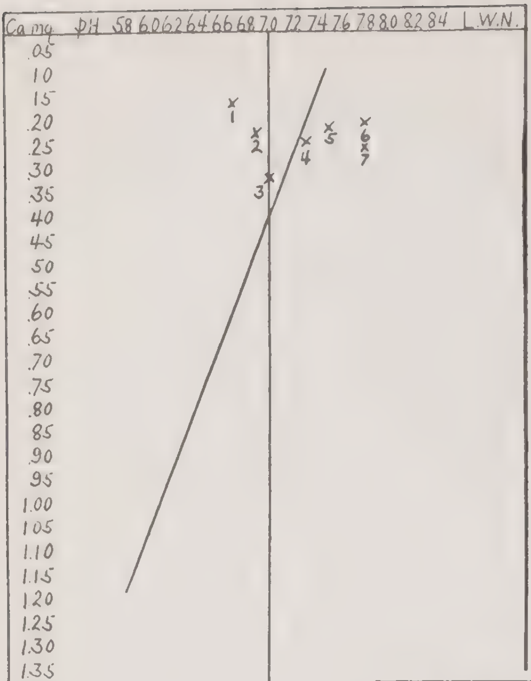


Chart VIII

Effect of well balanced diet on active decay case.

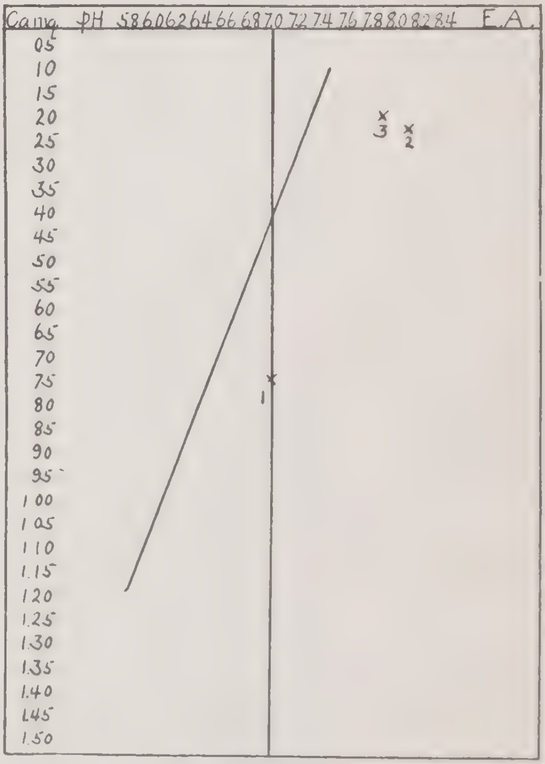


Chart IX

Effect of change of diet and the removal of toxin absorption on a pyorrhea case.

ical condition. After seven months the patient's weight had increased greatly and her color and general physical condition were exceptionally good. Although the patient was safely immune to decay, several months would still be necessary to increase the calcium level.

Chart No. IX. E.A. An active systemic pyorrhea case with considerable bone absorption and pus discharge from the many pockets: The patient was placed on a well balanced low phosphorus diet but decidedly alkaline. All the teeth from the upper arch were extracted and a few from the lower. In about eleven weeks the saliva was extremely alkaline with a great reduction in salivary calcium. His general health showed a marked improvement which was probably due to the character of the diet and the elimination of toxic absorption.

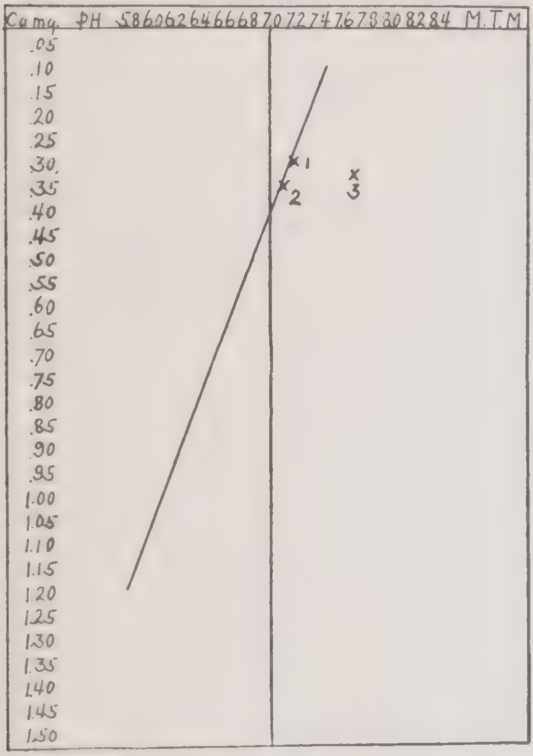


Chart X

Effect of alkaline and low residue diet on a decay case with tonsil enlargement.

Chart No. X. M.T.M. A six year old boy on a high cereal high vegetable diet had a great many fillings in his first teeth and two cavities in the six year molars. One tonsil was greatly enlarged and the patient was not in good health. No progress was made chemically in this case until the tonsil was reduced to fully half its original size by the low food residue character of the prescribed diet. In about 13 weeks on a well balanced diet the saliva was nicely alkaline with a slight increase in calcium. The patient's general health was much improved.

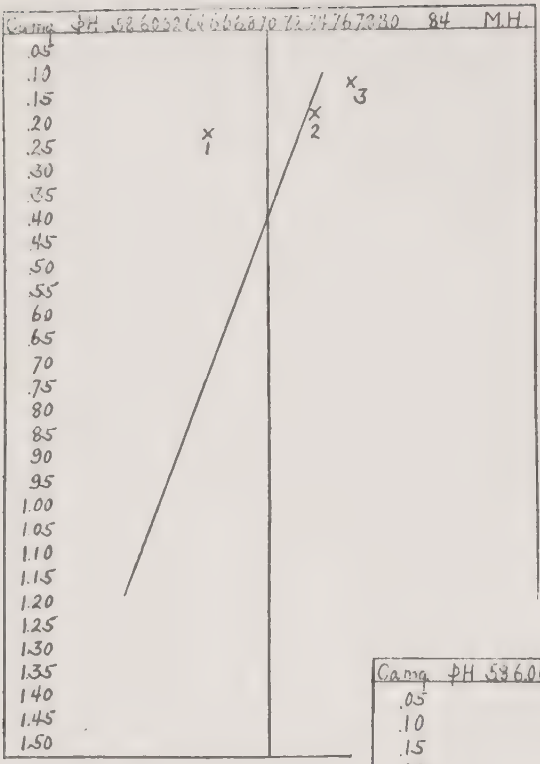


Chart XI
Effect of alkaline diet on decay case.

Chart No. XI. M.H. A 16 year old girl suffering from active decay with quite a few Class V cavities. In two months on a well balanced diet the tests showed she was im-

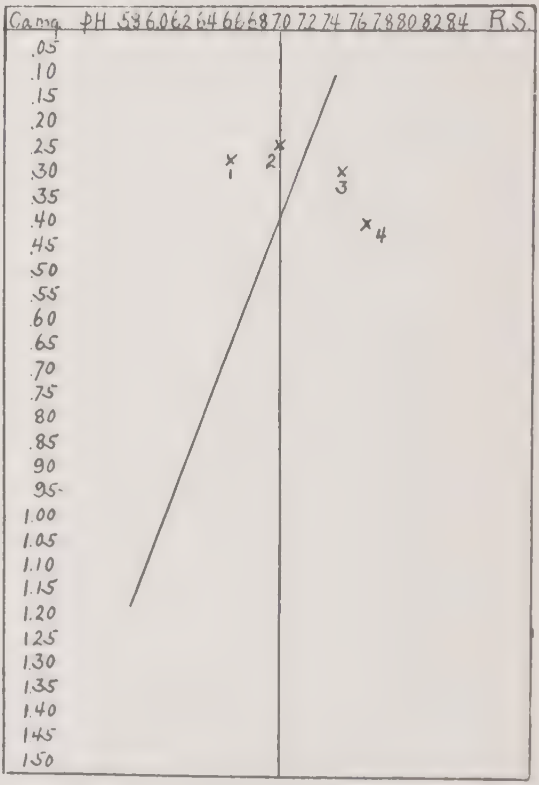
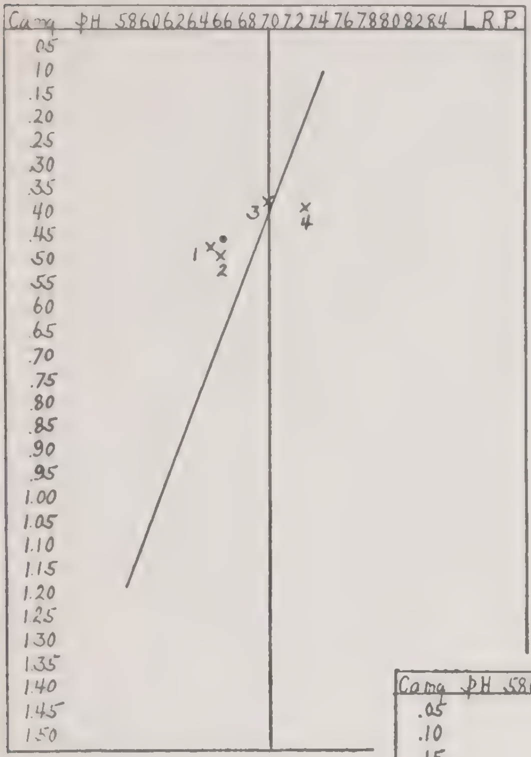


Chart XII
Effect of well balanced diet on decay case.



mune to decay. High Vitamin D and phosphorus feeding accompanied with an adequate amount of calcium would still be necessary to bring the salivary concentration of calcium to a higher level.

Chart No. XII. R.S. A woman about 38 years of age with considerable decay. Covering a period of eight months she passed to a safe margin of immunity. The progress was delayed on account of a severe influenza attack.

Chart XIII
Effect of alkaline diet on gingival decay.

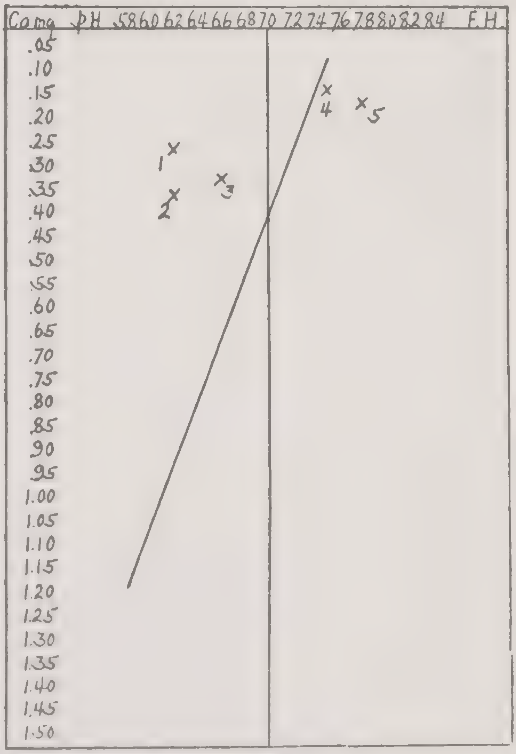


Chart XIV
Effect of well balanced diet on active tuberculosis case with considerable caries.

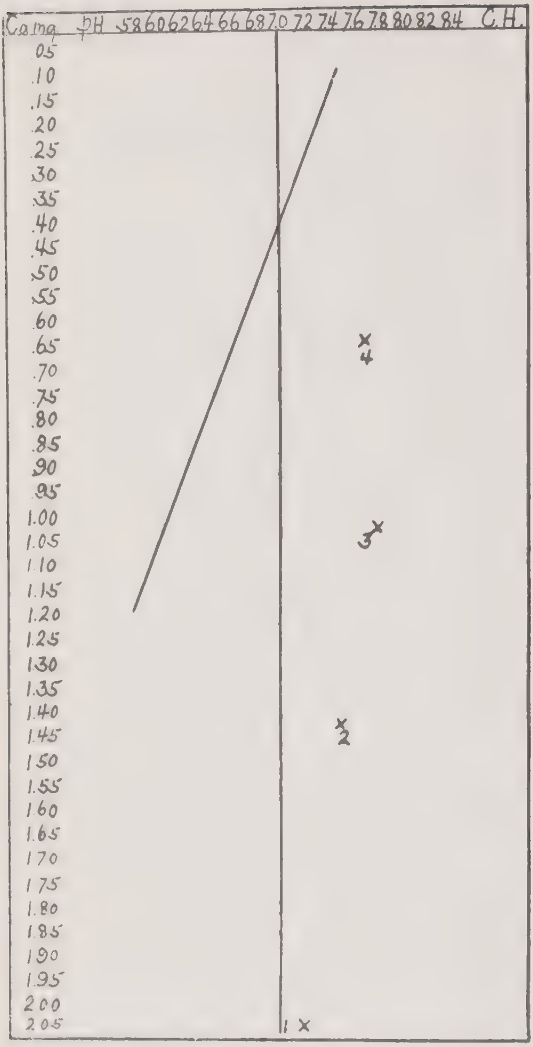


Chart XV
Reduction of salivary calcium by a suitable diet.

Chart No. XIII. L.R.P. A boy about 18 years old with considerable decay especially along the gingiva. In four months he was immune to decay due to favorable diet. At the present rate of progress two more months would still be necessary to give an ideal margin of safety.

Chart No. XIV. E.H. An active case of tuberculosis with considerable decay. The tests covered a period of 11 months, at which time she was making rapid strides toward complete recovery. Sevmonths would still be necessary to give her a safe margin of immunity as far as her caries is concerned.

Chart No. XV. C.H. A sixteen year old girl suffering from extremely heavy salivary deposits. The deposits were so heavy the biting surfaces of the lower arch were all that could be seen. A chisel and mallet were used to remove the accumulation. A highly alkaline diet was recommended, sufficient but not excessive in calcium. The phosphates were reduced. In five months the calcium content of the saliva was less than one-third the original amount and she was able to keep her teeth reasonably free from salivary deposits.

Many other cases could be shown illustrating the possibilities of improvement in alkalinity and calcium resulting from a changed diet program.

A practical application of the foregoing systemic factors as to the control of caries was undertaken at the Los Angeles Orphans Home in October, 1927, and completed in January, 1930. One hundred children from 3 to 13 years of age had their saliva tested as to its reaction and calcium content. Bite-wing X-ray films were made of each case and the number of open cavities, fillings and mouth conditions thoroughly examined and recorded. A research committee of three from the Los Angeles County Dental Society headed by Dr. Walter G. Crandall and the Supervising Dentist of the Los Angeles County Health Department, Dr. Hazel Merrick, made a careful oral examination of every mouth and all data was carefully recorded.

It was found that there was an average incident of caries of over 5½ cavities and slightly over 2 fillings per child. The mouth hygiene was very poor and a great many children had hypertrophy and inflammation of the gum tissue. No great effort was made to stimulate tooth brushing as the test was to be a check on the systemic factors involved, not on mouth hygiene.

The diet of the children was changed. A moderate meat, low cereal, high alkaline and calcium diet was fed during the period of test. Frequent salivary tests on the reaction and calcium of the children were made. When the tests showed a child to be low in alkalinity or calcium the diet was frequently supplemented with orange juice or cod liver oil.

During the period of test 26% of the children left the institution, most of them left during the summer vacation and it was not possible to make a final check on these. The remaining 74 children had another set of Bite-wing films made and were checked out by the same examiners. There were no new cavities found.

The gum tissue in the mouths of the children was good, all evidence of inflammation and hypertrophy had disappeared. The mouths were not so clean as when originally checked in and there was a slight increase in the percentage of tartar.

The result of this test or demonstration showed that the systemic factors responsible for caries and gum tone were completely under control. The fact that there were 555 cavities and many filled teeth in the group indicated a very marked tendency to caries. That this tendency was completely checked is very evident from the result obtained.

In January, 1930, another check was made on the remaining 41 children of the original group. Bite-wing films were made and the same personnel conducted the checking. One cavity was found under a Class II filling with a large overhang permitting a constant food retention. This is the only cavity developing at the institution in two and one-third years of demonstration.

CHAPTER

IV

ADJUSTMENT OF BODY CHEMISTRY BY FOOD MANIPULATION

It is important to understand how food influences the saliva and urine if we are to manipulate and change the body chemistry intelligently. In the following tabulation foods are classified into five groups according to their influence on the body chemistry. The direction of the arrows indicates in which way the body chemistry is moved by the particular food or foods eaten. When an arrow points upward it shows that this factor is increased in the saliva and urine and when the arrow points downward, that factor is decreased. Every article of food in the diet tends to move the body chemically in some direction. When we have become sufficiently familiar with the biochemical action of each class of food, we are able to change the body levels more or less at will depending upon the cooperation we can secure from our patient. This latter statement is predicated on the assumption that chemical tests have been run on the saliva and urine so the amount and character of food can be gauged to the assimilation of the individual. The following table should be memorized thoroughly. While it represents only a few of the important elements involved, yet their control tends to normalize other elements not shown.

Influence of Food Upon the Chemistry of the Saliva and Urine

		Acidity	K	Ca	Cl	P
1. Vegetables, potatoes and fruit.	Saliva	↓	↓	↓	↓	↓
	Urine	↓	↓	↓	↓	↓
2. Meat, fish, eggs and cottage cheese.	Saliva	↑	↑	↑	↑	↑
	Urine	↑	↑	↑	↑	↑
3. Butter, cream, fats and oils.	Saliva	↓	↓	↓	↓	↓
	Urine	↑	↑	↑	↑	↑
4. Cereals, bread, cake, all grain food.	Saliva	↑	↑	↓	↑	↑
	Urine	↓	↓	↑	↓	↓
5. Milk and cream cheese	Saliva	↓	↓	↑	↓	↓
	Urine	↑	↑	↑	↑	↑

The following chemical levels represent what is considered normal for children under fourteen and for the adult in terms of the amount of the element in milligrams per cubic centimeter. The pH reading shown is the buffer value expressed in terms of pH and represents the reaction of the saliva and urine after standing in contact with the indicator for one hour.

NORMAL OR IDEAL VALUES FOR THE AVERAGE CHILD

	pH	K	Ca	Cl	Ratio	P	Ratio
Saliva	7.8	0.833	.24	0.72	1	.152	1
Urine	6.0	1.666	.12	2.88	4	.600	4

NORMAL OR IDEAL VALUES FOR THE AVERAGE ADULT

	pH	K	Ca	Cl	Ratio	P	Ratio
Saliva	7.6	1.000	.37	0.90	1	.186	1
Urine	6.2	1.500	.10	2.70	3	.558	3

By memorizing the normal chemical values for both the adult and the child, as well as how food influences the chemical levels, we have the first steps necessary in changing or manipulating body chemistry.

Before working on an actual case it is quite helpful to test out these influences on our normal for the child or the adult. This study is hypothetical and the values are relative rather than exact. Nevertheless the direction of movement is correct and the chemical levels are close to the theoretical. We have selected the normal for a child to illustrate our deviations.

DEVIATIONS FROM NORMAL PRODUCED BY THE INTRODUCTION OF ONE CLASS OF FOODS AT A TIME

Normal (Child)	pH	K	Ca	Cl	Ratio	P	Ratio
Saliva	7.8	0.833	.24	0.72	1	.152	1
Urine	6.0	1.666	.12	2.88	4	.600	4
High Fat							
Saliva	8.1	0.555	.20	0.40	1	.100	1
Urine	5.6	2.220	.20	3.20	8	.800	8

As we study our normal values in comparison with the changes that are produced by one dietary move, which in this case was a high fat and oil intake, we are struck by the remarkable difference in the two readings. On a close inspection we see that all the mineral values of the saliva are less and all the urine values greater than those represented by our normal.

Also the pH of the saliva is more alkaline and the urine more acid than our original values. As the saliva represents retention values and the urine elimination values, we can see that fats have a demineralizing effect upon the body with a tendency in a normal person to increase alkalinity. As phosphorus is an acid element the alkalinity of the body will tend to rise or fall as this element increases or decreases. Note that the chloride and phosphorus ratios are increased with fats.

To make the influence of fats perhaps a little clearer, let us show the theoretical value when the fat and oil intake is one-half the normal.

	pH	K	Ca	Cl	Ratio	P	Ratio
Normal							
Saliva	7.8	0.833	.24	0.72	1	.152	1
Urine	6.0	1.666	.12	2.88	4	.600	4
Low Fat							
Saliva	7.4	1.221	.68	1.20	1	.220	1
Urine	6.6	1.221	.06	2.40	2	.440	2

As the percentage of fats decreases in the diet, all other elements remaining the same, the saliva shows a remarkable increase in retention values while the loss through the urine is reduced greatly. A reduction in fats, therefore, increases mineral retention with a correspondingly lower loss shown in the urine. The phosphorus ratio is reduced on a low fat intake. Because of the increased retention of phosphorus and less loss through the urine, the saliva alkalinity is less than our normal and the urine reaction shows less acidity and closer to alkaline values.

Let us consider a high phosphorus diet and its influence upon our normal.

	pH	K	Ca	Cl	Ratio	P	Ratio
Normal							
Saliva	7.8	0.833	.24	0.72	1	.152	1
Urine	6.0	1.666	.12	2.88	4	.600	4

High Phosphorus							
Saliva	7.6	0.999	.55	0.80	1	.180	1
Urine	5.8	1.998	.18	3.20	4	.720	4

A high phosphorus and a high protein diet are more or less synonymous as most of our phosphorus comes to us in meat, fish, eggs and the protein portions of seeds of all kinds like peas, beans, nuts and grain foods. If fats and oils are held to a constant, we will see as protein is increased, the phosphorus will rise in both saliva and urine due to an actual increase in that element. The chlorine will tend to rise slightly in the saliva and urine due to the fact that animal proteins carry more sodium chloride than the average of other foods. Calcium will be higher in the saliva and urine, not due to an increased intake, but due to the fact that phosphorus will mobilize more calcium from the bones of the subject. With more soluble and ionizable calcium in the blood due to the influence of phosphorus, the tendency for a loss of calcium is increased so saliva and urine almost always will show higher calcium values on a high phosphorus program. Potassium also will be increased in the saliva and urine due to the strong chemical affinity between potassium and phosphorus. When phosphorus is high, potassium is almost always high; and when phosphorus is low, potassium is almost always low. Due to the increase of phosphorus—an acid forming element—the buffer pH value is moved toward the acid range in saliva and urine.

When phosphorus foods are decreased we see the following changes:

	pH	K	Ca	Cl	Ratio	P	Ratio
Normal							
Saliva	7.8	0.833	.24	0.72	1	.152	1
Urine	6.0	1.666	.12	2.88	4	.600	4
Low Phosphorus							
Saliva	8.1	0.555	.20	0.60	1	.100	1
Urine	6.7	1.110	.08	2.40	4	.400	4

On a low phosphorus or a low protein diet it will be seen that all the elements like phosphorus, chlorine, calcium and potassium are decreased. Because phosphorus is decreased, the pH of the saliva and urine is moved decidedly toward the alkaline side.

Let us now consider the changes in the saliva and urine on a high vegetable and fruit intake, usually called a high potassium diet. There are two ways of increasing alkalinity, one by a drop in the phosphorus and the other by an increase in the dibasic potassium foods. The following illustrates the methods and results:

	pH	K	Ca	Cl	Ratio	P	Ratio
Normal							
Saliva	7.8	0.833	.24	0.72	1	.152	1
Urine	6.0	1.666	.12	2.88	4	.600	4
High Alkalinity (Low Phosphorus)							
Saliva	8.3	0.555	.15	0.60	1	.100	1
Urine	7.0	1.110	.08	2.40	4	.400	4
High Alkalinity (High Dibasic Potassium Foods)							
Saliva	8.3	1.666	.18	0.40	1	.152	1
Urine	7.0	3.332	.18	3.20	8	.600	4

The above table illustrates the two methods that will secure an increase in alkalinity of the saliva and urine. We are not considering here the results obtained by an increase in fats that secures an increased alkalinity of the saliva only, the urine being in that case more acid than our normal.

As you consider the first method of securing alkalinity—that is, a reduction of the monobasic phosphorus or acid protein foods—you will see a reduction in both saliva and urine of phosphorus, chlorine, calcium and potassium. The fall in phosphorus and chlorine is due to a decrease in intake. The reduction in calcium is due to an increase in insoluble calcium and a fall in soluble calcium which cuts down the loss through saliva and urine with an increased tendency for storage in the bones. The potassium is lower because it cannot be assimilated as readily. The phosphorus largely governs the assimilation and elimination of potassium. With a reduction in phosphorus there is an increase in alkalinity in saliva and urine.

In the second method of increasing alkalinity in the saliva and urine we maintain the normal phosphorus but increase the dibasic potassium foods. We will see that the total chlorine and calcium is the same, but the retention has been reduced as seen by the fall in the saliva values and the increase in the urine level as compared to our normal. This is due to the fact that potassium stands higher in the electromotive series and is able to displace both sodium chloride and calcium salts. An increase in potassium greatly increases the loss of chlorine and calcium in the urine. Because of the increased percentage of dibasic potassium salts over the monobasic form, the pH of saliva and urine is moved decidedly toward the alkaline.

A low alkalinity in saliva and urine is the same chemically as a high phosphorus program, especially one derived from the monobasic phosphates like meat, fish and eggs. If, at the same time, the acid phosphates are increased and the dibasic potassium foods like the fruits and vegetables are restricted, the fall in the alkalinity of the saliva and urine will naturally be intensified.

Let us now consider the changes in saliva and urine due to high calcium foods. In one case we will show the changes occurring when skim milk, buttermilk or calcium tablets or wafers are taken. These may be di- or tricalcium phosphate, calcium carbonate, calcium lactate or any other product low in fat and protein. In another case we will show where rich whole milk or cream cheese is used as the source of calcium.

	pH	K	Ca	Cl	Ratio	P	Ratio
Normal							
Saliva	7.8	0.833	.24	0.72	1	.152	1
Urine	6.0	1.666	.12	2.88	4	.600	4
High Calcium from Skim Milk, Buttermilk and Tablets							
Saliva	7.8	0.833	.45	0.72	1	.152	1
Urine	6.0	1.666	.15	2.88	4	.600	4
High Calcium from Rich Milk or Cream Cheese							
Saliva	8.0	0.666	.30	0.51	1	.120	1
Urine	5.8	1.998	.20	3.09	6	.720	6

In high calcium products that are low in fats and phosphorus there should be little or no change in the mineral elements from our normal with the exception of the calcium which should be very high in the saliva, provided assimilation is excellent.

In products that are high in calcium and also high in fats and oils, we have the combined effect of the two influences. The high calcium increases the total calcium levels of the saliva and urine and the fats whip up phosphorus assimilation causing an increased mineral loss through the urine. The phosphorus and chloride ratios are naturally increased in proportion to the fat increase, provided fat assimilation is normal.

When the calcium intake is low or assimilation is poor and the diet is otherwise adequate we see the following changes from our normal.

	pH	K	Ca	Cl	Ratio	P	Ratio
Normal							
Saliva	7.8	0.833	.24	0.72	1	.152	1
Urine	6.0	1.666	.12	2.88	4	.600	4
Low Calcium							
Saliva	7.8	0.833	.15	0.72	1	.152	1
Urine	6.0	1.666	.05	2.88	4	.600	4

The above figures illustrate the effect of a low calcium diet on an otherwise good diet program. We see the only marked change in our chemistry is in the levels of calcium which are low for both saliva and urine.

In considering cereals it must be borne in mind that this class of foods is more than a good source of starch. It is high in sodium, magnesium and phosphorus. The protein is relatively high and the fats are low unless they have been added. Cereals have a high acid ash content. When they are added in high concentration to our normal diet with no increase in fats and oils, the following is the average picture to be expected. We also show what would be expected with a high cereal and high fat intake.

	pH	K	Ca	Cl	Ratio	P	Ratio
Normal							
Saliva	7.8	0.833	.24	0.72	1	.152	1
Urine	6.0	1.666	.12	2.88	4	.600	4
High Cereal, Normal Fat							
Saliva	6.9	1.665	.20	1.44	1	.300	1
Urine	6.9	1.262	.25	2.16	1.5	.450	1.5
High Cereal, High Fat							
Saliva	7.8	0.833	.09	0.51	1	.150	1
Urine	5.2	3.332	.36	3.09	6	1.200	6

As can be seen from the above illustrations, cereals have some marked influences very different from the other foods that have been considered. Where fats are low, a high cereal intake usually increases the retention or has a marked kidney checking action on all the elements considered but calcium. The increased calcium loss seen here may be due to the fairly generous level of magnesium found in grain food. Excessive magnesium in the diet tends to displace and throw calcium out through the urine. Since cereals cause the retention of most minerals their effect upon the chemistry of the body is just the opposite to that of fats and oils which increase the loss. It must not be overlooked that calcium is usually thrown out of the body by fats and when both cereals and fats are present in quantity, the loss of calcium is usually extremely high.

We now have another element to consider, namely, chlorine. This is usually secured in the form of sodium chloride or table salt. The following shows the general influence of sodium chloride on the body chemistry. This influence can best be shown when the chlorine intake is too low as compared with our normal.

	pH	K	Ca	Cl	Ratio	P	Ratio
Normal							
Saliva	7.8	0.833	.24	0.72	1	.152	1
Urine	6.0	1.666	.12	2.88	4	.600	4
Low Sodium Chloride							
Saliva	7.9	0.721	.10	0.40	1	.130	1
Urine	6.5	1.442	.05	1.20	3	.520	4

When sodium chloride is reduced or low in the diet, the retention is not exactly in proportion to the total consumption. Nature tends to retain a greater portion of the total sodium chloride when the intake is greatly reduced so the chloride ratio is increasingly less as quantity drops. As the chloride level runs parallel with the hydrochloric acid level of the stomach, a deficiency in retention naturally interferes with the digestion of all proteins, as meat, eggs or the casein of milk and will tend to reduce the total phosphorus and calcium levels. A fall in calcium and phosphrous is to be expected with a fall in chlorine. As a result of the reduced phosphorus assimilation the alkalinity is increased. Inasmuch as potassium assimilation and elimination runs more or less parallel with the level of phosphorus, we see a fall in total potassium when chlorine and phosphorus fall. Many cases with low calcium and phosphorus levels have a low chloride intake. The retention of chlorine is dependent, largely, on the assimilation of potassium, sodium and fats.

There are a number of other elements we do not measure in our routine tests that are of considerable importance, as sodium, magnesium and sulphur. A few words on each of these might not be amiss.

Our tests with sodium showed us that it tended to increase the holding capacity of the body for chlorine. In fact, the chlorine level fell when sodium was low or was displaced by potassium. A high sodium level is very desirable when chlorine retention is poor.

The element magnesium has a marked displacing action on calcium when consumed in such products as Milk of Magnesia. Magnesium is an essential element, but its use in quantity must be guarded against as it reduces saliva alkalinity as well as causes a fall in the retention of calcium. The loss of calcium on a high magnesium intake may be as high as two or three hundred per cent above normal.

Sulphur is an acid element and its effect upon the alkalinity of the body is very marked. Such products as mustard, if used in quantity, will depress the alkalinity of both saliva and urine to a marked degree.

In the foregoing paragraphs an effort has been made to show the influences of potassium, sodium, calcium, magnesium, chlorine, sulphur and phosphorus as well as fats and oils on the body chemistry. In regulating the chemical levels of the body by food manipulation it is necessary to make the maximum number of changes at the same time. After a little experience it is possible to normalize a chemistry by several moves made simultaneously. This is difficult at first but soon can be accomplished with ease.

In discussing food and its influences upon the body chemistry we have used hypothetical illustrations drawn as accurately as possible. It might be profitable to show the influence of fats and oils on a few actual cases. In studying the changes in the pH, calcium and phosphorus, it is well to remember that the Phosphorus Ratio is a very accurate index of the liver's capacity to assimilate fats and oils, provided inorganic phosphorus from soft drinks or medicaments is out of the diet. It is possible for free inorganic phosphorus to pass through the intestinal wall without the aid of fats, but this is not possible for phosphorus in combination with organic compounds.

The influence of Fats and Oils on the pH, Calcium, Phosphorus, and Phosphorus Ratio of Actual Cases:

		pH	Ca	P	P Ratio
J.C.	Saliva	7.1	.42	.233	1
	Urine	5.9	.16	.537	2.4
		Increase in fats and oils.			
	Saliva	7.4	.28	.143	1
	Urine	5.6	.32	.957	6.7
R.P.	Saliva	6.8	.41	.366	1
	Urine	6.1	.13	.763	2.1
		Increase in fats and oils.			
	Saliva	7.1	.28	.296	1
	Urine	5.9	.22	1.216	4.1
W.G.R.	Saliva	7.9	.20	.176	1
	Urine	6.1	.22	.584	3.3
		Decrease in fats and oils.			
	Saliva	7.5	.33	.220	1
	Urine	7.1	.12	.296	1.3

Having studied the above influences of fats and oil on the chemistry where there was normal liver function, it might be of interest to show the changes on two cases of liver impairment where bile had to be used to secure function. (See discussion under "torpid liver.") Watch the phosphorus ratio which illustrates the changed capacity to assimiliate fats.

The Influence of Whole Pig Bile on the pH, Calcium, Phosphorus and Phosphorus Ratio.

		pH	Ca	P	P Ratio
M.L.H.	Saliva	7.4	.16	.231	1
	Urine	7.0	.09	.437	1.9
	½ Pint Table Cream added to Diet.				
	Saliva	7.2	.17	.273	1
	Urine	7.3	.12	.446	1.6
	6 Pig Bile Tablets per day and ½ Pint of Table Cream.				
	Saliva	7.4	.27	.188	1
	Urine	7.3	.09	.455	2.4
	12 Pig Bile Tablets per Day and ½ Pint of Table Cream.				
	Saliva	7.5	.52	.211	1
	Urine	6.9	.25	.789	3.7

		pH	Ca	P	P Ratio
D.H.C.	Saliva	7.1	.30	.469	1
	Urine	8.0	.05	.118	0.3
	6 Pig Bile Tablets per Day.				
	Saliva	7.6	.23	.269	1
	Urine	6.7	.05	.197	0.8
	12 Pig Bile Tablets per Day. ½ Pint Table Cream.				
	Saliva	7.5	.41	.262	1
	Urine	5.3	.07	.569	2.2
	9 Pig Bile Tablets per Day. Considerable Butter and Olive Oil.				
	Saliva	7.8	.25	.214	1
	Urine	5.5	.18	1.071	5.0

Because of the fat splitting enzymes of the pancreas that organ has a definite roll in the assimilation of fats. This influence can be shown by studying the pH, Calcium, Phosphorus and Phosphorus Ratio of the following cases. The following tabulation is more or less self-explanatory. It might be well to note that when pig bile was given to a pancreatic case, the phosphorus ratio decreased in both cases. This is exactly what we would expect to happen. We must remember there is a balance between the pancreas and liver. When the pancreas is over-active it depresses liver function and the reverse also is true, an over-active liver will depress the pancreas. Our Vitamin B test which is a wonderful index of pancreatic function, shows this same antagonism between the liver and pancreas. A bilious attack can be caused easily by feeding a very high Vitamin B intake to a sluggish liver case. In the tabulation a marked increase in the phosphorus ratio and total phosphorus is shown when pancreatin was introduced showing it to be definitely the deficient factor.

The influence of Whole Pig Bile and Pancreatin on the Phosphorus Ratio:

		pH	Ca	P	P Ratio
G.R.	Saliva	7.3	.38	.232	1
	Urine	6.1	.16	.616	2.7
	½ Pint of Table Cream per Day.				
	Saliva	7.3	.23	.242	1
	Urine	7.2	.15	.556	2.3
	½ Pint of Table Cream per Day. 6 Pig Bile Tablets.				
	Saliva	6.9	.42	.247	1
	Urine	7.5	.10	.417	1.7
	½ Pint of Table Cream per Day. 6 Pancreatin Tablets.				
	Saliva	7.1	.53	.388	1
	Urine	5.2	.45	1.324	4.0
		pH	Ca	P	P Ratio
C.B.H.	Saliva	7.3	.24	.197	1
	Urine	7.5	.07	.243	1.2
	½ Pint of Table Cream per Day.				
	Saliva	7.3	.38	.151	1
	Urine	6.2	.13	.402	2.7
	½ Pint of Table Cream per Day. 6 Pig Bile Tablets.				
	Saliva	7.5	.24	.142	1
	Urine	7.0	.16	.294	2.1

½ Pint of Table Cream per Day.
6 Pancreatin Tablets.

Saliva	6.7	.17	.087	1
Urine	6.1	.15	.900	10.3

Since the above studies were made it has been found possible to stimulate the pancreas with Vitamin B Complex, so pancreatin usually can be dispensed with. It usually is advisable to make a vitamin study in each case. When that is done any shortages in Vitamin B will be seen and corrected readily.

There is a type of acidosis not usually considered when diets are being regulated, i.e., organic acids in food which the body cannot handle. Most organic acids are broken down to carbon dioxide and water. Any food containing benzoic or oxalic acid cannot be so broken down and becomes an important source of acidosis. Prunes, plums, cranberries, sour cherries and rhubarb come under that classification and should be restricted.

There are, however, certain individuals who find it difficult or impossible to break down fruit acids which most people can handle, such as citric, tartaric and malic acids. An individual possessing such an idiosyncrasy might not be able to handle the organic acids in such foods as the strawberry, orange, grapefruit, lemon, apple, peach, tomato, etc. In that case, the food in question should be avoided. Symptoms of skin rash, edema and aphthae stomatitis result from marked inability to handle this class of foods. Others have no marked symptoms and suffer an acidosis.

It has been found that an inability to handle highly acid fruits and vegetables is quite common in individuals with a very low hydrochloric acid level of the stomach and those that are definitely hypothyroid.

A method has been worked out to recognize such cases. Individuals who can break down completely all organic acids in foods have a definite relationship between the phosphorus content of the saliva and the buffer pH. In other words, a definite reaction of the saliva would call for a certain level of phosphorus. We have worked out this relationship on over six hundred cases. If we find the pH falling too far below the phosphorus level we know there are organic acids that are not being broken down. By food manipulation it is possible to locate the offending acid. In making this check, tobacco in all forms and mustard must be eliminated for twenty-four hours.

The following tabulation gives this relationship of pH to phosphorus:

The Relationship Between the Buffer pH of the Saliva and the Phosphorus Content

pH	P	
	No Interference	Practical Values
8.4	.104	.040
8.3	.122	.059
8.2	.140	.078
8.1	.158	.097
8.0	.176	.115
7.9	.194	.132
7.8	.212	.150
7.7	.230	.168
7.6	.248	.186
7.5	.266	.204
7.4	.284	.221
7.3	.302	.239
7.2	.320	.257
7.1	.338	.275
7.0	.356	.292
6.9	.374	.308
6.8	.392	.326
6.7	.410	.344
6.6	.428	.362
6.5	.446	.380
6.4	.464	.398
6.3	.482	.416
6.2	.500	.434
6.1	.518	.452
6.0	.536	.470
5.9	.554	.488

The column marked "No interference" refers to an individual who completely breaks down all organic acids and whose diet does not contain interfering factors like high sulphur foods as mustard, and tobacco in any form. The column under "Practical Values" presents a figure that allows for some interference, but not of sufficient magnitude to require correction. If the values in this column are used as a minimum compared with the buffer pH, skin rashes and mucous membrane disturbances do not seem possible.

When we find the buffer pH to fall below the expectancy for a given phosphorus level, we know that there are interfering substances which will have to be eliminated from the diet. These may be high citric and malic acid foods or fats and oils the body is unable to oxidize.

By means of the above chart offending foods that depress alkalinity usually can be located. If a raise in the basal rate or an increase in chloride retention is not practical or cannot be accomplished, the offending foods will have to be reduced or eliminated if relief from disturbing symptoms is to be realized.

Urinalysis

In addition to the establishment of the mineral levels on the saliva and urine there are a few fundamental tests that should be run on the urine to eliminate the possibilities of certain pathological conditions. I refer to tests for acetone, sugar, urates, albumen and specific gravity. While the number of these tests could be extended, yet those mentioned will furnish essential information quite desirable in diet regulation without embarking too far into the pathological field.

If acetone is strongly positive in the face of a low phosphorus ratio which indicates a low fat assimilation and the history shows a fair carbohydrate intake we are justified in suggesting a sugar tolerance test be run. It always is advisable to test for sugar in the urine in such cases, although its absence is no assurance that the sugar tolerance is normal.

The presence of urates in quantity is indicative of poor protein digestion. Urates are commonly found when salivary chlorine is low, particularly when there is a negative basal metabolic rate.

The test for albumen is always a desirable precautionary measure. The presence or absence of kidney infection should be known by anyone attempting to regulate a diet or to manipulate body chemistry.

A high specific gravity usually runs parallel with a high phosphorus level, yet this is not always the case. The cause of a very low or high specific gravity should be established if possible.

Stool Analysis

It would seem that the actual pH and the presence of occult blood are the minimum tests on the stool desirable for nutritional work. The pH of the normal stool runs through a very narrow range. This seems to be from pH 6.8 to 7.0 When the stool becomes much more acid than this range, a loss of tone takes place in the colon with hemorrhoids or an atonic colon resulting. When the stool is too alkaline, putrifaction is taking place with a tendency for a spastic colon. Severe colitis is quite common when stools are either very acid or very alkaline.

The reaction of the stool can be varied by manipulating the carbohydrates or protein, raising or lowering the chlorine retention, and increasing or decreasing the amount of bile. The reaction also can be changed by manipulating the fat and oil intake as well as the amount of Vitamin B.

The presence of occult blood may be due to several causes as bleeding piles, fissures, ill-fitting trusses, presence of parasites, etc. The occurrence of blood in the stool is of considerable importance, especially in anemia cases.

Vitamin Study

In regulating a diet it is very essential that the levels of the most important vitamins be known. Without this information the nutritionist is under a severe handicap. Supplying the body with the theoretical or so-called "Established Vitamin Requirements" is not sufficient as vitamin assimilation and retention varies greatly from one person to another. This will be discussed as the individual vitamins are considered.

Vitamin A

Our tests show the startling fact that 70% of our patients are borderline or definitely short in Vitamin A. We have overlooked the fact that this vitamin is not very stable, especially as to heat. A high percentage of Vitamin A is injured or destroyed in the pasteurization of milk and butter. Cooking eggs, carrots, spinach and all high sources of this essential factor is detrimental. The prevalence of night blindness and the common cold gives convincing evidence of this deficiency.

It is perfectly possible to consume a generous intake of this vitamin and still have low body levels. We must not forget that Vitamin A is a fat soluble vitamin and requires normal fat assimilation. Any impairment in liver function conspires to defeat the body's ability to secure an adequate intake. We have found that Carotene (pro-vitamin A), as found in foods like raw carrots, is much more efficient in raising the body level than the Vitamin A secured in fish liver oils. It is claimed that carotene is readily stored in the liver in quantity while only a small quantity of true Vitamin A can be so stored. If we accept this claim, most of the Vitamin A secured should be in the form of pro-vitamin A or Carotene.

In view of the evidence secured by the use of a Vitamin A test in nutritional work over a considerable period of time, we are convinced that the pasteurization of both milk and butter and the cooking of carrots contributes largely to the terrific shortage of this vitamin in our diets. Every effort should be made to secure a safe milk supply so the pasteurization of both milk and butter will not be necessary. It is difficult to keep butter that is not pasteurized, yet it can be accomplished if suitable refrigeration is maintained constantly.

Vitamin A reduces the cholesterol level of the blood and appears to promote its utilization. So constant is this relationship it is possible to use the level of cholesterol as an index of the level of Vitamin A in the body. Vitamin A levels secured in this way tend to run parallel with the photometer readings in the study of the incident of night blindness and the tendency to contract the common cold. A suitable daily dosage for Vitamin A in the form of Carotene is about 10,000 International Units per day and a higher unitage is necessary when fish liver oils are used as a source. Most individuals can maintain a normal Vitamin A level by the use of one raw carrot per day.

Vitamin B Complex

Our tests on Vitamin B show 28% of our patients short in this factor. This is not surprising when we consider that we have only a few foods that are a very rich source of this vitamin. The entire or whole grain foods and those that contain the germ or embryo in quantity are only indifferently used by the masses. This class of food together with asparagus and the avocado, comprise the three outstanding foods in common use rich in Vitamin B. This vitamin is closely related to amylase or the starch splitting factor in the pancreas. In fact, it is doubtful whether starch can be broken down in the body without one or more members of the Vitamin B complex being present.

Our test for Vitamin B is, we believe, an accurate means of measuring the ptyalin level of the saliva. The ptyalin level always seems to run parallel with the amylitic serum enzymes of the blood and the amylitic enzymes of the external secretion of the pancreas. It is our belief that these amylitic ferments have a common source and are one and the same, and are present in the external secretion of the pancreas as well. Our research shows that Vitamin B_1 and other members of the complex can break down starch in a synthetic buffer mixture. We used a mono- and dibasic potassium phosphate solution proportioned to give a pH of 7.5 or 7.6. Water solutions of Thiamin Chloride, Wheat Germ and Brewer's Yeast added to the suggested buffer with either raw or cooked starch were capable of hydrolyzing the starch on incubation.

In the body the capacity to break down starch generally runs parallel with the Vitamin B intake in the presence of an increasing starch consumption. In other words, a definite amount of starch requires a definite amount of Vitamin B for suitable digestion. Intestinal gas and the tendency for an acid stool increases if Vitamin B is greatly reduced in the presence of a high starch intake. An atonic colon is usually associated with deficiencies in Vitamin B.

There is also a definite relationship between the liver and the pancreatic function. When our phosphorus ratio is very low, say 1 to 1 or 1 to 1.5 in the presence of a generous intake of fats and oils we know there is an inadequate liver function as far as bile production is concerned. Under such conditions we expect a very active amylitic reaction, usually much above normal even in the presence of low or average Vitamin B consumption. The reverse also is true—an underactive pancreas (one low in amylitic activity) will tend to encourage liver function. There seems to be a definite balance—and in a sense an antagonism—between the liver and the pancreas as they operate on fats and carbohydrate foods.

The principal action of Vitamin B_1 seems to be on carbohydrates. When Thiamin Chloride is fed to a case deficient in Vitamin B, no material change takes place in phosphorus assimilation. When this vitamin is fed in Wheat Germ and Brewer's Yeast or an amylitic ferment as in Pancreatin, we see usually a marked increase in the total phosphorus level. This could be due to the phosphorus these foods contain or to the presence of another vitamin or other members of the B complex or to another enzyme. Because of the high phosphorus content of Wheat Germ and the tendency it has to depress the alkalinity of the body to a point that would be called an acidosis, the amount of this product fed in a 24 hour period should be limited to two rounded tablespoonsful. Wheat Germ is a very rich and inexpensive source of Vitamin B and there is no reason for not using it in amylitic deficiencies, provided suitable restrictions are made as to the amount consumed in a definite period. As wheat germ is low in calories it cannot be used as a substitute for a breakfast cereal. It does, however, supplement a breakfast cereal nicely.

When it is desirable to increase weight by speeding up the body's capacity to handle carbohydrates, a concentrate of Vitamin B Complex seems to be far superior to Thiamin Chloride (B_1). On the other hand, when a quieting action on the nerves is desired, as in cases of rheumatism and neuritis or to secure relief from extreme fatigue of muscles especially in thighs and legs, Thiamin Chloride is greatly to be preferred. This latter product, being free from phosphorus and the tendency to cause an acidosis, can be given in almost unlimited quantities without fear of an overdose. From one to five milligrams is a common dose in such conditions. It is claimed that complete relief from severe cases of tic douloureux has been secured by the administration of giant doses of Vitamin B_1. It would seem that a high calcium and high Vitamin B program would be the most effective method of quieting inflamed or supersensitive nerves.

If Brewer's Yeast is fed as a source of Vitamin B in general diet regulation a daily intake equivalent to 125 International Units is usually sufficient to maintain suitable levels.

When Vitamin B is used to stimulate lactation, 750 to 1000 International Units may have to be fed. The Vitamin B Complex is much more effective than Vitamin B_1 for conditions that do not specifically involve the nerves.

Vitamin C

A study covering the Vitamin C levels in the saliva and urine reveals only a comparatively few persons in Southern California are short in this essential factor. Our data shows about 1% of our cases are short in summer and about 5% short in winter. It is probably true that this deficiency percentage would not hold good for certain other sections of the United States. In districts where fruit and vegetables are not available in quantity in the winter months, a much higher percentage of deficiency of Vitamin C is to be expected. In the United States as a whole, it is likely that the number of persons seriously low in this food factor are comparatively few. Some of the improvements seen in the general health when fruits and vegetables are fed, are due to other factors than the Vitamin C they contain. The use of pure Cevitamic Acid is the only way to prove the value of this vitamin in animal experiments. The use of orange juice as a source of Vitamin C in animal experiments is open to considerable question.

The minimum body's requirements for Vitamin C have been given as 150 International Units which is equivalent to 7.5 milligrams of Cevitamic Acid. Three times the minimum body requirements or 450 International Units provides the generally accepted optimum requirements. Two ounces of orange or lemon juice furnishes 460 International Units of Vitamin C or the optimum body requirement. One good-sized juicy orange or one-half grapefruit will provide our optimum requirement if no other Vitamin C foods are being consumed. The consumption of a glass or more of fruit or vegetable juice

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per day is absolutely not necessary from the standpoint of preventing a Vitamin C shortage.

For the average individual the consumption of a large glass of fruit juice every day is more of a liability than an asset as the high potassium intake tends to lower muscle tone, reduce the calcium level of the body, decrease the hydrochloric acid of the stomach, and may cause an acidosis if the body is unable to oxidize the excessive intake of organic acids.

Aside from the Citrus Fruits (oranges, grapefruit, lemons, limes, etc.), there are many other foods rich in Vitamin C. Some of these are cantaloupes, watermelons, strawberries, raw cabbage slaw, raw onions, canned and fresh peas, canned and fresh tomatoes and watercress. The chance that a person would be short in Vitamin C on a well balanced diet is very slim indeed. This is borne out by our tests showing hundreds of cases covering the full calendar year.

In running Vitamin C tests on both the saliva and urine a much more accurate check is made than on either saliva or urine alone. The saliva level shows the retention of Cevitamic Acid and the urine shows what is being eliminated after the body has met its requirements. In a sense the urine level can be regarded as an excess after the body has removed what is necessary for body function. While this usually is true, yet there are times when the body's chemistry is such as to discourage retention with the result that the urine level may be quite high and the saliva level below our normal limits. A high fat and oil intake has a demineralizing effect upon the body. Vitamin C is equally affected, so when fats are high we expect to see a decrease in the anticipated saliva level and an increase in the loss through the urine.

In 1000 c.c. of normal saliva we expect to have 2.0 to 2.4 milligrams of Cevitamic Acid. This amount seems to be sufficient to protect the body against a deficiency. If we find in one liter of urine 7.5 milligrams of Cevitamic Acid, which is the minimum body requirement for this vitamin, we are sure the body is amply protected against a shortage. Especially is this true if the saliva level—which is the retention level—is not below our normal limits. If the amount of Cevitamic Acid in the saliva and urine together does not fall below 9.5 milligrams there is little likelihood of a shortage.

The body requirement for Vitamin C varies considerably in certain cases. In all wasting diseases as Tuberculosis or any condition that reduces a person to a state of emaciation, the requirements for Vitamin C seem to increase greatly. In such cases it seems best to take the large amount of Cevitamic Acid required to maintain a suitable level in the form of the synthetic product, rather than subject the patient to the detrimental effects of the potassium intake found in fruit or vegetable juices.

In the average normal individual the Vitamin C requirement usually can be met on a well-balanced diet without giving much thought or consideration to the matter. On the other hand, where no raw fruits or vegetables are being consumed or where the physical condition calls for an increased consumption, vigilence should be exercised to see that this essential food factor is being supplied adequately.

Vitamin D

With the use of the "Phosphatase Test" as an index of the level of Vitamin D in the body, we find a deficiency of from 47% to 52% in this factor during the late fall and winter months in Southern California, or an average of 45% for the full calendar year. This is a very startling disclosure and explains the probable reason for the high incident of rickets in certain parts of the United States and to some degree the prevalence of caries.

While Vitamin D is only one factor out of many that influences the level of calcium in the body, it is a very important one as a suitable level of calcium and phosphorus can hardly be maintained without it. When an adequate dosage of Vitamin D is taken either in the form of a Vitamin D concentrate from fish liver oils or from Ultra Violet light, a marked increase in calcium and a slight improvement in the phosphorus levels may be seen in both saliva and urine. It is not at all uncommon to secure an increase in the saliva calcium of at least 100% in two weeks on oral therapy where suitable doses are being administered. Vitamin D therapy in the form of full body irradiations is much slower, but just as effective. Ultra Violet light usually takes from two to three months to raise calcium to a maximum level. This method has the advantage over oral administration in that it usually takes two months to lose the benefit obtained. While oral therapy raises Vitamin D values in two weeks to a maximum, this can be lost in a like period on discontinuing the therapy.

We have found that small doses of Vitamin D are not very effective in obtaining suitable calcium levels in the saliva. A minimum of 1000 International Units of Vitamin D per day is necessary for adequate results in either the child or adult. Doses of 1800 to 2000 units are still better.

When Vitamin D is fed by mouth in the form of a standard Cod Liver Oil a marked increase in phosphorus as well as calcium is seen. This increase is due to the presence of a high intake of oil which whips up phosphorus assimilation. If Vitamin D is fed in a concentrate where little oil is ingested or if this vitamin is secured by Ultra Violet light only a slight increase in the phosphorus level will be seen. The principal influence of pure Vitamin D is on the calcium.

Vitamin D has an influence on iron assimilation. Calcium acts as a catalyst for iron and visa versa. For some reason

Vitamin D in the form of Ultra Violet light seems more effective in correcting simple anemia than when fed by mouth in the form of fish liver oils.

There are certain persons who cannot assimilate Vitamin D from fish liver oils but can secure it from sunbathing or Ultra Violet light. This may be due to inadequate liver function. On the other hand, there are those who cannot secure this vitamin from Ultra Violet light but can assimilate it by mouth from fish liver oils. This latter condition may be due to a lack of cholesterol in the oils of the skin.

By running tests for phosphatase, calcium and phosphorus the influence of Vitamin D therapy can be measured readily.

It is felt generally that Vitamins A and D are related in some way. We would like to add that the level of bile or bile salts may also be related to these vitamins. It has been shown that Vitamin A reduces the level and possibly increases the utilization of cholesterol in the body. It is thought by some that cholesterol is the "mother substance" of bile salts. Crude cholesterol can be changed to Vitamin D by the action of Ultra Violet light. A threatened bilious attack can often be averted by a sunbath. Whether this is due to the Infra-red or Ultra Violet rays time will tell. This inter-relation of Vitamins A and D as well as cholesterol and bile salts offers some very interesting speculations. When these relationships are finally worked out another advance in medicine will have taken place.

CHAPTER

V

OBSERVED CHEMISTRY IN DENTAL PATHOLOGY

The following is a brief statement of the outstanding chemical deviations found in dental conditions. This will permit a comparison of some of the different pathological states as well as furnishing a basis for diet regulation.

Dental Caries

In occlusal caries, especially in children, we commonly find a high calcium—low phosphorus state as far as the blood stream is concerned. This does not mean that the calcium is usually above normal, but rather, a condition exists in which the calcium is ahead of the phosphorus. When the phosphorus is raised to normal the true picture will be seen. The calcium level will fall and then be shown to be deficient. Because of the low phosphorus ratio with a low urinary and a fairly high salivary phosphorus the buffer pH of the saliva shows a marked acidity. Both the saliva calcium and saliva phosphorus are generally below normal in this form of caries. The calcium cannot leave the blood stream and appear in the saliva unless it can be mobilized and pulled out of the blood by a suitable acid radical, like phosphorus.

We are showing the average chemical levels of over two hundred cases of active caries as follows:

	pH	Ca	P	P Ratio
Saliva	6.88	.27	.210	1
Urine	6.87	.20	.403	1.9

It will be seen from the above that the saliva is less alkaline than our normal and the urine less acid. The calcium content of the saliva is low and the amount found in the urine excessive. The saliva phosphorus is above normal and the amount in the urine is decidedly below normal.

The potassium is usually a little high, chlorine retention a little low, and fats and oils a little low. Vitamins B and D are frequently low and Vitamin A occasionally low. Simple anemia is frequently present.

SOFT GINGIVAL CARIES

This condition generally is seen in young adults, but may appear at all ages. It is quite common in women who are on a reducing diet and are living largely on fruits, vegetables and pastry with little or no milk and meat. The chemistry is similar to occlusal caries in children, i.e., low calcium and phosphorus. We are showing a case illustrating this condition:

		pH	Ca	P	P Ratio
D.H.C.	Saliva	7.3	.10	.247	1
	Urine	8.4	.14	.292	1.2

Potassium is usually very high because of the high fruit and vegetable program. Fats and oils may be low or high. When fats are high—due to salad oils, etc., there is a greater percentage of phosphorus lost through the urine and as a result the buffer pH of the saliva is not depressed greatly.

The saliva alkalinity is usually below normal but is generally more favorable than the caries reaction in children. Vitamin D tends to be low or deficient.

A low basal rate due partially to the low protein intake and anemia are important factors in this class of case. White lines of decalcification around the necks of the teeth are often early manifestations of this type of caries.

ABRASION

This is a condition of excessive wear either on the occlusal or biting surfaces. Abrasion may be seen also on the smooth surfaces of the tooth. The buffer pH is either normal or only slightly depressed. The calcium is quite low but sufficiently high to prevent caries. When the calcium remains relatively low with only a slight amount of immunity as to caries over a considerable period of time, the teeth become quite soft as compared to the normal state. The teeth are then in a state where coarse or abrasive foods or tooth pastes and powders or the opposing teeth may abrade or remove the enamel exposing the dentin. By raising calcium the teeth can be hardened gradually. It usually takes eight to twelve months to harden teeth when once they are soft.

EROSION

The term "erosion" should be limited to a highly polished area on the tooth, usually at the gingiva, but may be found on the labial, buccal or lingual portions of this structure. There is always an acid mouth condition when true erosion is active. When it occurs on the labial and buccal portions of the tooth the chemistry shows the buffer pH of the saliva to be quite acid and the calcium to be much higher than in soft gingival decay. While the calcium may seem to be fairly high it is not sufficient to insure immunity and protect the tooth against the acids of fermentation. In erosion the principal neutralizing capacity is in the calcium and that is not sufficient for protection. The phosphorus in this state is usually quite high and it is actively mobilizing calcium and causing a loss either through the saliva or urine. Pyorrhea is generally active in states of erosion. We are showing the chemical levels for a case of this type:

		pH	Ca	P	P Ratio
H.B.	Saliva	6.7	.47	.202	1
	Urine	5.9	.15	.357	1.8

The potassium as well as fats and oils are ordinarily high in this condition. The cause of lingual erosion usually has a different etiology and is caused by acid regurgitation from the stomach; a spastic pylorus or sluggish liver are important contributing causes.

Non-Typical Caries

There are a number of ways in which lime salts can be removed from a tooth other than by the acids of fermentation. These lesions may resemble at times those of typical caries or erosion; they have, however, a different etiology.

Some few years ago when iron was administered in liquid form by mouth, a very disastrous form of tooth disintegration was seen. This condition is hardly ever seen today.

Then we have a type of erosion-like lesion caused by the careless use of hydrochloric acid. If the mouth is not thoroughly washed with water following the use of any strong acid like hydrochloric, considerable damage to the teeth can result if the practice is continued over a period of several years.

It is not generally known, but a fact, that many types of sucking candies contain enough organic acid to disintegrate the teeth in a localized area where the candy is held. This action probably is not due to fermentation as tests reveal the amount of organic acid is sufficiently strong to cause tooth disintegration if the candy is kept in contact with the tooth over some period of time.

PYORRHEA

This is a state in which the body is not able to hold its calcium or the intake does not balance the loss. On account of this faulty relationship there is a disintegration of the alveolar process surrounding the teeth with the eventual loss of these organs. All other bones of the body are affected but because the alveolar bone is quite spongy in character the loss is more apparent than in the denser bones of the body.

There are three known calcium--phosphorus balances seen in pyorrhea cases.

The first, and most common, is a low calcium high phosphorus state. This is associated generally with high potassium and high fat intakes. The chlorine retention is usually poor. The buffer pH is less alkaline than normal.

The second and much less common form has a low calcium-low phosphorus balance. The intake of both calcium and phosphorus is not equal to the body's loss or outgo of these elements. There is a gradual body depletion. The potassium as well as fats and oils are much lower than the first type although they vary somewhat. The retention of chlorine is frequently high. The buffer pH normally quite alkaline and often above normal.

The third type is quite uncommon and the balance is high calcium-low phosphorus. From all appearances another element like sulphur is mobilizing the body calcium and causing a loss. The potassium and fats are fairly low while chlorine retention is fairly normal. The buffer pH is ordinarily depressed.

A series of cases will be given showing the pH, calcium and phosphorus of the saliva and urine of the different types of pyorrhea.

Type I

1.—Poor Gum Tone or Hypertrophic Type with Salivary Deposits.

		pH	Ca	P	P Ratio
D.G.	Saliva	6.9	.83	.245	1
	Urine	6.9	.17	1.324	5.4

2.—Poor Gum Tone or Hypertrophic Type without Salivary Deposits.

M.E.	Saliva	6.3	.98	.292	1
	Urine	5.5	.23	.918	3.1

3.—Good Gum Tone or Anemic Type with Salivary Deposits.

W.M.C.	Saliva	7.3	.60	.110	1
	Urine	5.4	.32	1.452	13.2

4.—Good Gum Tone or Anemic Type without Salivary Deposits.

L.M.	Saliva	7.5	.14	.165	1
	Urine	5.7	.12	1.286	7.8

Type II

5.—Good Gum Tone or Anemic Type without Salivary Deposits with Low Phosphorus.

P.A.F.	Saliva	7.8	.13	.144	1
	Urine	6.0	.18	.455	3.2

Type III

6.—Good Gum Tone or Anemic Type with High Calcium and Low Phosphorus.

L.G.	Saliva	8.1	.25	.191	1
	Urine	6.3	.09	.385	2.0

Type I

7.—Pyorrhea and Caries going on Simultaneously.

R.C.	Saliva	7.0	.16	.352	1
	Urine	6.5	.13	.918	2.6

EXCESSIVE TARTAR

When salivary deposits form readily, especially on the lower anterior teeth, a pyorrhea balance frequently is present. The buffer pH is commonly below normal as to alkalinity and often quite acid. In terms of pyorrhea these cases should be included in Type I. We find potassium, phosphorus and fats generally very much above normal.

GUM RECESSION

When the gums appear to be receding and a portion of the root of the tooth is being exposed it usually is due to the absorption of the underlying bony process or to the rising of the teeth out of their sockets. If pyorrhea or abnormal stress is causing the absorption of the alveolar process, the overlying soft tissue will usually follow the bone and gum recession occurs. When alveolar absorption is due to abnormal stress the so-called "calcium-phosphorus balance" is probably always out of correct relationship.

If teeth lose their opponents in the opposite arch there is a tendency for the teeth to rise in their sockets until a contact is made. This condition simulates gum recession. Any tendency for the exposure of the root of a tooth calls for an explanation and prompt interference to the end that the abnormal condition may be checked.

HYPERCEMENTOSIS

This condition usually is found in a high calcium-low phosphorus balance. It is common in hypertrophic arthritis and in cases with deficient liver function. It is found associated with dental decay rather than pyorrhea. Hypercementosis can be caused by mild stimulation from areas of infection.

PERIAPICAL INFECTIONS

This condition occurs most commonly on the death of the pulp. When these apical infections are associated with a low calcium-high phosphorus balance the roentgenograms reveal large areas of translucency. When the balance shows high calcium-low phosphorus the areas of absorption are usually small and in some cases cannot be demonstrated with X-rays. All infections in the body, no matter where located, tend to throw the buffer pH toward the acid side.

PULP STONES

The number of teeth exhibiting pulp stones are very few indeed. While most teeth with stones have been filled previously due to caries, this is not universally the case. Due to the anatomy of the pulp chamber many so-called pulp stones prove to be artifacts on sectioning the tooth. Not all teeth with pulp stones give pain or symptoms. We also find teeth with sharp shooting pains in which pulp stones cannot be demonstrated. Eliminating cases with apical infections and acute pulpitis, we find low calcium in practically all cases exhibiting sharp shooting pains. If calcium can be raised sufficiently the pain tends to subside.

MOTTLED ENAMEL

Quite a few tests have been run on persons with mottled enamel. These tests did not reveal anything abnormal so far as the buffer pH, calcium and phosphorus were concerned. In districts where the water has a high fluorine content it would seem likely that some deviation from normal in the bone-building elements might be demonstrated.

STAINED TEETH

Eliminating tobacco as a cause, we frequently see red, yellow, green and dark stains on the teeth. There is a general tendency for these mouths to have a depressed alkalinity. Microscopic examinations from the areas often show higher bacteria and mold forms. A normal alkalinity of the mouth plus good oral hygiene seems to correct the difficulty in most cases. A reduction in cereal foods is frequently helpful.

Vincent's Infection

This condition is attributed to the Spirillum Vincenti and the fusiform bacillus. These organisms are facultative parasites, i.e., they live usually as saprophytes but may become parasites when conditions are favorable. The favorable condition for parasitic existence seems to be a depressed tone or congested mucous membrane with slight blood seepage. This, together with a fair amount of food residue, especially from cereal foods which on fermentation give a distinct acid mouth condition, seems to furnish the ideal environment.

The body chemistry that predisposes to an attack is a high phosphorus level which usually gives an acid mouth with congestion. Low Vitamin A is an additional factor as well as poor mouth hygiene. When such a mouth is exposed to an unusually virulent strain of Vincent's organisms, infection is more or less inevitable. Mouths that are suitably alkaline with firm healthy mucous membranes do not contract this infection, especially if good mouth hygiene is practiced.

Canker Sores or Aphthae Stomatitis

This is a very annoying condition and usually quite painful. These small or large ulcers are due to poor mucous membrane tone. A temporary depression in the alkalinity of the mouth is generally all that is necessary for an explosive attack for those who are susceptible. Any foods that can depress the natural alkalinity of the mouth sufficiently can be responsible, as rye bread or rye crackers in quantity or the excessive use of highly acid fruits or juice beyond the body's capacity to oxidize them. When canker sores occur in an alkaline mouth the mucous membrane tone is poor due to Vitamin A deficiency or poor general health.

Burning or Stinging Mouths

This condition is fairly common and is more prevalent among denture patients. The fact that most types of material used for denture bases are poor conductors of heat contributes to the condition. Acid, feverish and congested mouths are the ones ordinarily affected. A high cereal and acid fruit program or poor liver function can contribute to the difficulty.

Most of these cases with burning mouths can be improved or the condition completely relieved. A changed and improved body chemistry is the answer to the problem. Anemia is also a possible cause. Mouth washes and local treatments with medicaments are usually worthless and often aggravate the condition.

Excessive Mucin

Mouths with stringy saliva are very annoying and make the wearing of dentures very difficult. This condition is caused frequently by the excessive use of cereal foods and sweet pastry. Most cases of this kind can be improved greatly or modified by a reduction or elimination of the above articles of food.

Quantity of Saliva

There is a considerable difference in the amount of saliva produced by different individuals. Dry mouths are often caused by hypothyroidism. A high cereal diet low in fruits, vegetables, and liquids is a contributing factor. A low Vitamin A level seems to be a factor in some cases.

The cause of excessive saliva is much more difficult to determine. Mouth irritation seems to be an important factor. A depressed mouth alkalinity is often seen. The use of certain drugs aggravates the condition. Hyperthyroidism may be a factor in a small percentage of cases.

In general an improved body chemistry seems to normalize the amount of saliva in most cases.

Narrow Dental Arches

Irregular and impacted teeth and narrow arches are proof in themselves of faulty body chemistry during the formative period. It has been noted that children on a highly refined cereal diet with pasteurized milk are more prone to have narrow and under-developed arches than those on a low intake of the entire grain product plus a liberal intake of raw milk especially if the milk is from cows that are being grazed on green pastures. The liberal use of animal protein as meat, fish or eggs is quite necessary during the formative period of bones and teeth, as one quart of milk will not take care of the phosphorus requirements of the body at that time.

CHAPTER

VI

OBSERVED CHEMISTRY AS RELATED TO SYSTEMIC SYMPTOMS AND AILMENTS

In checking the chemistry of those with dental decay, pyorrhea and other dental difficulties, many systemic conditions were noted. It soon became apparent that there frequently was a correlation between the chemistry and the symptoms. When the chemistry was placed in or near a correct level there was often a modification in the severity of some systemic disturbances that were related. A great deal of this type of data has been accumulated in regulating over five thousand cases. Because of the value of these observations to the physician and biochemist this chapter has been included.

In the following chapter a brief statement of the observed chemical peculiarities found in a number of systemic disturbances is given.

Asthma

Asthma is an allergic condition with excessive nerve response. As a class asthmatics are too alkaline as shown by the buffer pH of the saliva. The total potassium, phosphorus and fat and oil assimilation usually is much too high. The retention of calcium and chlorine is very poor. Vitamins A and B and occasionally D tend to be deficient. The stool is usually too acid. Occasionally the basal metabolic rate is too negative.

To Normalize: Introduce a program of high calcium and sodium foods. High sodium chloride and high Vitamins A, B and D are important positive steps in this correction. All foods containing potassium and fats and oils should be very low. The basal metabolic rate will have to be raised when it affects calcium assimilation. The administration of bile or bile salts is hardly ever indicated in asthma cases.

Hay Fever

Hay fever is an allergic state and is more concerned with the mucous membrane and skin tone than with excessive nerve irritability.

The buffer pH of the saliva may or may not be too alkaline. The potassium, phosphorus and fats and oils tend to be too high. The calcium tends to be low while chlorine is usually excessively low. Vitamins A and D may be low. Vitamin B is usually normal or perhaps high. The urates may be high in the urine. The stool may be decidedly alkaline with intestinal putrifaction. The urates and amine end-products of faulty protein splitting are important causes of the poor mucous membrane tone. When there is a sluggish liver with an alkaline stool, a small amount of bile will acidulate the colon and often give complete relief from symptoms.

To Normalize: Reduce potassium and all fats and oils, as well as Vitamin B when quite high. Increase sodium chloride and Vitamin A. Reduce protein foods if too high. Give bile when indicated.

SKIN RASHES

Only skin rashes due to metabolic disturbances will be considered. Rashes may be due either to an inability to oxidize organic acids or to an allergic background. Poor liver function often causes a dry desquamation.

When rashes are due to a failure to oxidize organic acids like citric and malic or to fatty acids we find the basal metabolic rate too negative or the hydrochloric acid too low or both conditions operating. In this state we usually find the buffer pH of the saliva depressed below the theoretical level due to the presence of unoxidized organic acids. The potassium, phosphorus and fats are usually high. Calcium and chlorine are usually low. Vitamin A is often low. Urates may be present and the stool may be alkaline. The basal metabolic rate is often quite negative.

Essentially the same deviations may be found in the pure allergic type with the possibility that Vitamin B may be deficient.

When skin desquamation is due to poor liver function the chemistry is very different. The buffer pH is definitely toward the acid side due to a retention of acid waste products which are not eliminated. The total potassium and phosphorus are usually low, yet the retention is usually above normal. The calcium and chlorine depends upon the intake of milk or calcium products and table salt. The fat assimilation is very poor. An alkaline stool is usual unless the patient is on a low protein and high vegetable and fruit regimen. The capacity to digest starch is above normal as the pancreas lacks the restraining influence of normal liver function.

To Normalize: Raise hydrochloric acid or chlorine retention when necessary by a low potassium and fat program plus a high sodium and sodium chloride intake. Raise the basal metabolic rate with a suitable iodine product or thyroid gland substance. Withhold any acid fruits and vegetables, also difficult proteins as egg white. Increase liver function when that organ is responsible for the difficulty. Vitamin A should be high.

THE COMMON COLD

Studies on individuals having frequent colds show no constant chemical reaction that can be assigned to the syndrome. The opinion that colds are associated usually with an acidosis is not borne out by chemical analysis. There are too many persons who are extremely alkaline when colds are contracted to accept the acidosis theory in whole or part as the chief predisposing factor. Being in good chemistry implies much more than the pH reaction. The reaction of an individual is no doubt important in the general resistance of the body, and being either too acid or too alkaline is a liability.

The only single factor that our tests have revealed deficient or out of balance in those individuals subject to constant colds is Vitamin A. Individuals who can maintain a high Vitamin A level in the body are extremely resistant to colds. The intake of Vitamin A in quantity, especially from fish liver oils, is no guarantee of a suitable level. Poor liver function generally prevents assimilation. Vitamin A taken in the form of carotene usually is assimilated without disturbances and is much more effective in maintaining a level.

To Normalize: A well balanced diet plus at least 10,000 International Units of carotene per day generally will prevent colds. One raw carrot per day, either grated or whole, usually is effective. It ordinarily takes about two weeks to raise the Vitamin A level of the body to prevent or stop a cold.

SINUS INFECTIONS

These infections are usually found in chemical balances quite similar to those responsible for allergy. High potassium, phosphorus and fats with low calcium, chlorine and Vitamin A is usual.

To Normalize: A high intake of carotene is paramount. Increase calcium and reduce potassium, phosphorus and fats.

NIGHT BLINDNESS

A deficiency in Vitamin A is the single outstanding factor.

To Normalize: Use not less than 10,000 Units of carotene per day. One raw carrot per day for a period of a few weeks also is effective. It is wise to take carotene in some form continuously as a preventive measure.

LEUCORRHEA

Leucorrhea often is associated with poor muscle tone which tends to cause intestinal displacement or ptosis with congestion in the pelvic area. In these cases we see a tendency for frequent colds or sinus difficulty. The chemical balance is quite similar to that causing poor skin or mucous membrane tone. The diet frequently is too vegetarian with considerable salad oils and fats with an insufficient amount of meat and table salt. There is occasionally a sluggish liver with a retention of toxic wastes which intensifies the symptoms. There usually is a lack of exercise especially of the trunk of the body. There is a possibility that there may be a connection between the endocrine system and vitamins in this condition.

To Normalize: More exercise involving the trunk of the body is necessary. Increase animal protein, table salt and Vitamin A in the diet. Use less fruit and fruit juices as well as fats and oils.

INTESTINAL PTOSIS

In intestinal ptosis we usually find the same chemical, physical and nutritional picture as is found responsible for leucorrhea. (See instructions under leucorrhea.) In addition we might add a Vitamin B deficiency which causes a very acid stool with a dilated or atonic colon.

CONSTIPATION

Eliminating surgical cases or where adhesions are a factor we can assign one or more of the following conditions as a reason for most constipation.

1. Lack of exercise.
2. Lack of bulk in the diet.
3. Lack of sufficient water or liquid.
4. Spastic ani muscles.
5. Hemorrhoids or piles.
6. Atonic colon.
7. Spastic colon.
8. Pancreatic insufficiency.
9. Torpid liver.
10. Vitamin B deficiency.

Most of these reasons suggest their own remedy. Atonic and spastic colons might call for some further data. Spastic colons are usually caused by too alkaline intestinal contents. This is brought about by too high an animal protein diet, or an insufficient amount of hydrochloric acid, or a lack of vegetables or starch foods, or too high an intake of Vitamin B, a sluggish liver, or a combination of several factors. Spastic ani muscles are caused by the same syndrome as spastic colons, plus low calcium.

Atonic colons are usually caused by too acid a stool. This is brought about by any one or a combination of the following factors: too high a fruit, vegetable, starch or sugar intake;

insufficient pancreatic activity, especially as it involves the amylitic ferment; not enough Vitamin B; or not enough animal protein. Piles or hemorrhoids usually develop during periods of relaxed or atonic colons.

To Normalize: Test the reaction of the stool. If it is not within the range of pH 6.8 to 7.0 proceed to apply the above information or, better still, run a complete chemical check-up on the body so the exact reasons for the faulty reaction can be established. This treatment coupled with a reasonable amount of exercise plus sufficient water and bulk should correct the condition.

Colitis

Eliminating infection, colitis cases with gas, mucus and ulcers are all associated with too acid or too alkaline an intestinal tract. When the stool is too acid there is usually an atonic colon with possible ulcers, mucus and excessive gas. The diameter of the stool when formed is very large. Intestinal ptosis, hemorrhoids or piles are commonly associated with this type of colitis.

When too alkaline a stool exists a spastic colon is to be expected. In this type excessive mucus is common together with toxic and hay fever symptoms. There usually is only a slight tendency for intestinal gas.

To Normalize: Consult the material under constipation and proceed to correct the reaction of the colon. If the pH of the colon is kept from 6.8 to 7.0 any marked pathological symptoms are very uncommon.

Hemorrhoids and Piles

An atonic and very acid colon is the environment that seems to promote the formation of hemorrhoids and piles. When hemorrhoids are once formed, a change to an alkaline reaction of the colon does not always cause a material reduction in the size of the lesions or their elimination although it does in some cases. The evidence is against the formation of these lesions in the presence of an alkaline stool or in one with a normal pH.

Duodenal Ulcers

The so-called stomach ulcer always seems to be formed in a high hydrochloric acid state. When once these ulcers are formed any acid such as the acids found in fruit or vegetable juices or the acids of fermentation can cause irritation and discomfort. Fermentation and the acids resulting from it take place when hydrochloric acid is low. Some physiologists feel that ulcers can be caused by these acids. This is contrary to our present belief based on many observed cases.

A normal hydrochloric acid level never seems to irritate or prevent the healing of an ulcer. An abnormally high hydrochloric acid level or the presence of organic acid in quantity does irritate and prevent healing.

The chlorine level of the saliva seems to run parallel with blood chlorides when the saliva does not contain mucus. When mucus is present in quantity in the saliva the chlorine values are usually much too high and will not check with blood chlorides. The blood chlorine tends to run parallel with the hydrochloric acid level of the stomach. Therefore, it is possible to use the saliva chlorine as a fairly reliable index of the subject's hydrochloric acid level when suitable care is used as to the character of the sample.

When the saliva chlorine is normalized and fruit and vegetable acids are restricted, most ulcer cases exhibit no discomfort and healing appears to be taking place.

To Normalize: Even though we believe a high hydrochloric acid level was necessarily present at the beginning of a duodenal ulcer case, we have found the hydrochloric acid level to be either high or low in cases of long standing. Normalizing the hydrochloric acid level in such cases is of prime importance. The hydrochloric acid level usually can be maintained by a suitable intake of sodium chloride and foods high in sodium and a level of potassium and fatty foods sufficient to secure a normal retention of chlorine. It is the balance between potassium, sodium, chlorine and fats that seems to regulate the hydrochloric acid level.

High and Low Blood Pressures

Our tests seem to indicate quite a number of factors are involved in the blood pressure levels—as calcium and chlorine retention, quantity of liquids consumed and retained, liver function, kidney function, muscle tone of heart and vascular system, presence of irritants in blood stream, several endocrine factors, and the presence of hardened arteries, as well as the nervous stability and mental state or makeup of the patient.

In low blood pressure cases we often find potassium and fats and oils high, and sodium chloride, basal metabolic rate and Vitamin B low.

In high blood pressure cases we often find poor liver function. In this condition there is usually a high sodium chloride intake and foods high in sodium, like the cereals, are generally present in quantity. Foods high in potassium are inclined to be quite low.

To Normalize: Let us first consider the low blood pressure case. Increase the table salt, remove all fruit and vegetable juice, keep fats and oils as low as possible. Support the basal metabolic rate with thyroid if the case is quite negative. Keep meat and cereal foods fairly high. Vitamin B should be high.

In reducing a high blood pressure case eliminate all cereals and grain foods. Substitute potatoes and bananas as energy foods. This will reduce greatly the toxic wastes. Give whole bile or bile salts if there is any liver dysfunction. Keep potassium foods like fruits and vegetables reasonably high. Reduce nerve irritability by giving calcium foods like milk. If blood pressure does not start to fall in a few days, use iodine in suitable form. Iodine frequently has been found to be quite helpful and probably increases the thyroid's capacity to oxidize toxic waste products. The bowels, of course, should be kept open.

DIZZINESS

The sensation of dizziness or light headedness usually is associated with extremes in blood pressure. Because low blood pressure is so much more common than high blood pressure we see many more cases of dizziness associated with the former condition than the latter. The chemistry for high and low blood pressure and its normalization is discussed under that title in another paragraph.

HEAT EXHAUSTION

The exhaustion that occurs in very hot weather is due to the very low blood pressure that results from a period of profuse perspiration. Because large amounts of sodium chloride and water are lost in the perspiration the blood and saliva chlorides fall below the normal levels in this condition. There is also a loss of acid phosphates in the perspiration which increases the alkalinity of the body.

To Normalize: Rest and quantities of table salt in water are usually all that are required to obtain recovery.

FATIGUE OR EXHAUSTION

Feeling tired especially in the afternoons is due usually to low blood pressure, a low basal metabolic rate or to anemia. Occasionally we have all three conditions operating at the same time.

To Normalize: Establish the cause of the condition. To raise blood pressure consult the paragraph under that heading; to normalize the basal metabolic rate consult that title; anemia also will have a separate paragraph.

HYPO- AND HYPERTHYROIDISM

The number of cases with an over-active thyroid is very few compared with the number of persons with a deficiency in this gland. Most of the over-active cases seem to be caused by infection rather than by physiological states. Large doses of Vitamin A in these cases tend to slow down thyroid activity by either eliminating infections or neutralizing toxic products.

An estimation of the Basal Metabolic Rate based on the pulse, temperature and blood pressure, when properly taken and controlled, seems to be about as accurate as that taken by the usual laboratory methods. In this comparison, we use as a normal for the average adult a pulse of 78, a temperature of 98.6° F. and a blood pressure of 100 plus the age less 10. The pulse pressure should be between 30 and 40 during the prime of life. Children should have higher pulses and higher temperatures while the aged have slower pulses and lower temperatures. The evidence seems to indicate that most hypothyroid cases are not due to a deficiency of the thyroid gland alone but are multi-glandular in character in which the thyroid, anterior pituitary and gonads are factors. The pulse rate seems to be connected actively with the thyroid gland function while the temperature seems to be definitely connected with gonadal function. When the thyroid is inactive we expect slow pulse rates, when the gonads are deficient in activity, subnormal temperatures. When thyroid is given the pulse is generally quickened. In that case the temperature may be raised, lowered or no change seen. When Vitamin E is given the temperature is raised and the pulse in that case may be lowered, raised or show no change.

When the body weight is carried principally above the waist it appears that the gonads or sex function is usually more active than the thyroid. The reverse also seems to be true, for, when the weight is carried below the waist, the thyroid activity appears to be greater than gonadal function.

When the pulse is very slow and the temperature only slightly depressed, thyroid in conservative doses makes for a correction. When the pulse is only slightly depressed and the temperature shows a marked depression, sea kelp, a high iodine and Vitamin E product, tends to normalize the condition. Where both pulse and temperature are markedly depressed, therapy including both thyroid and kelp seems to give the most effective results.

The highest percentage of hypothyroid cases comes from the goiter districts. This condition is more prevalent among women than men and is more common among those who are not using iodine foods, as salt water fish, regularly. It is evident that iodine deficiencies are very common in the United States.

Sterility

There apparently are many causes for this condition as evidenced from our patients' histories. Aside from anatomical deviations the following causes have been noted: acidosis, infections in the body, history of mumps, being overweight or underweight, a lack of a high level of Vitamin E and a low basal rate.

Many cases have been corrected by eliminating infection, correcting the acidosis and feeding a high iodine and Vitamin E food like sea kelp. Pregnant women with histories of stillbirth or a failure to carry to full term seem to respond beautifully to sea kelp.

Acidosis and Alkalosis

In a survey in Southern California covering a great many cases with dental pathology, we found 48% of our patients too alkaline and 32% too acid. The term "acidosis" or "alkalosis" should apply to the reaction of the blood stream and not to the reaction of the stomach, colon or urine. Our tests show that stomach or urine reactions cannot be used as a reliable index of the blood stream condition. Tests made simultaneously on the blood serum and properly taken saliva samples tend to run parallel but do not have the same numerical values. Paraffine never should be used to stimulate the saliva collection, as it gives values more alkaline than normal.

There are many factors involved in an acidosis or alkalosis. For example we list the following: the percentage of basic and acid-ash foods consumed and assimilated; the amount of fats and oils assimilated; the capacity of the body to oxidize organic acids from fruit and vegetables as well as those derived from fats as fatty acids; also the presence of kidney dysfunction. Acidosis can be caused by heavy smoking, high alcoholic drinks and serious infections in the body as well as soft drinks containing acid phosphates.

The average case of acidosis or alkalosis cannot be corrected by manipulating the percentage of acid or alkaline ash foods alone. The absolute cause of the deviation from normal must be ascertained before an attempt is made to restore the reaction to normal.

Fats and oils when oxidized and assimilated increase the alkalinity of the body. If there is liver dysfunction or poor oxidation of the fats, then the use of fats and oils to increase alkalinity will result in failure.

If fruits and vegetables are used to alkalinize, then the percentage of organic acid as citric, malic and tartaric is important as failure will ensue if these acids cannot be oxidized or broken down to carbon dioxide and water. The percentage of hydrochloric acid in the stomach and the basal metabolic rate largely controls the capacity of the body to oxidize these acids.

In establishing a correct reaction in the body all factors must be considered before an attempt is made to manipulate food. After a proper study has been made it may be found that food is not the cause of the difficulty. To manipulate food when the source of trouble is either poor assimilation, poor elimination, failure to oxidize acid foods, infections in the body, or the presence of some other factor like heavy smoking or drinking is to attack the problem from the wrong end. Most cases of acidosis can be corrected if properly approached.

The fact that 48% of our cases had an alkalosis should tend to dissipate the belief that an acidosis exists generally in the public as a whole. In an effort to get away from an imaginary acidosis the alkaline foods in general have been over-emphasized. It would seem that an increase in meat, fish and eggs in the average diet is greatly indicated.

Bilious Attacks

Nausea or bilious attacks occur when there is an interference with the normal flow of bile. It may be due to an obstruction in the bile duct or to the failure of the liver to produce enough bile. An infection in the gall bladder and bile duct which causes a closure of the normal bile channels is responsible for quite a percentage of intermittent attacks. However, the greatest percentage of bilious attacks seems to be due to a failure of the liver to produce enough bile. This torpid liver condition usually dates back to a serious infection in the body. Such infections as typhoid fever, malaria or amebic dysentery are responsible for a high percentage of them. Quite a percentage of sluggish liver cases with no history of infections have a record of the use of phenolphthalein in quantity over a period of time.

When there is a slightly sluggish liver the type of diet or certain articles of food may spell the difference between attacks or freedom from them. Coffee is perhaps the most serious provoker of bilious attacks. Eggs and a diet too high in fat are also contributing causes as well as a low hydrochloric acid level.

There are other causes of nausea as that of pregnancy. This is often due to too low a starch or carbohydrate diet and too high a fat intake early in pregnancy. An endocrine disturbance can cause bilious attacks. Vitamin E also seems to be a factor.

When our tests show a very low phosphorus ratio as 1 to 1 or 1 to 1.5 on a mixed diet the normal fat assimilation is impaired and there probably is a sluggish liver or an interference with the bile flow. The use of whole bile or bile salts usually eliminates nausea when it is due to a torpid liver.

Spastic Pylorus

Regurgitation caused by a constricted or spastic pylorus is due to faulty body chemistry. Moreover, it is very doubtful if it often is due to over-development of the muscles of that region. Usually the outstanding chemical deviations in these cases are an alkalosis, low calcium and low hydrochloric acid level. Most of these cases start when the patient becomes imbued with the "vegetarian complex" in which little or no sodium chloride or no milk products are being consumed. The value of operations in functional conditions where there is no serious anatomical deviation from normal is open to question.

To Normalize: Increase sodium chloride or give hydrochloric acid by mouth. Keep potassium and fatty foods very low. Introduce meat in the form of very rare Salisbury Steaks. Buttermilk or a soluble calcium product is desirable until the normal hydrochloric acid level is established, then a low-fat sweet milk or buttermilk can be used.

CYSTITIS

Eliminating specific infections, most cases of cystitis seem to have a background in too acid or too alkaline a urine. The chemistry of individuals with an acid urine is very different from that of individuals with an alkaline urine.

Those cases of cystitis with very acid urines usually have a low calcium—high phosphorus balance with a history of fats and oils quite high. High sulphur may be a factor if considerable mustard is being consumed. Occasionally the ingestion of benzoic or oxalic acid fruits such as prunes, plums, cranberries and rhubarb may be factors. Most soft drinks contain an acid phosphate.

In cases with acid urines keep fats and oils as low as possible. Reduce acid foods like meat, fish, eggs and bread if in excess. Reduce condiments and eliminate soft drinks. Use skim milk and a high vegetable and potato program until relief is secured.

The very high alkaline urine type of cystitis often is due to liver dysfunction which prevents the elimination of acid waste products. It also can be attributed to a strict vegetarian program. If the cystitis is due to a torpid liver use whole bile or bile salts. The diet should contain sufficient meat, fish and eggs to acidulate the urine properly. Restrict fruit and vegetables temporarily. All alkaline products and laxatives should be eliminated.

ARTHRITIS

No effort will be made to discuss the part played by microorganisms in arthritis but rather we will classify the cases as to chemistry.

The most important relationship seems to be that of calcium to phosphorus. Three definite chemical relationships and two clinical types have been noted.

The hypertrophic type is associated with a high calcium—low phosphorus balance. This tends to cause a deposition of lime salts at or near the articulations. The intake of calcium may not be high, but on account of the low phosphorus level the calcium is not mobilized and the holding capacity is high. This means that there is insufficient phosphorus to balance the amount of calcium and keep it in soluble form, therefore, the excess calcium is deposited as an insoluble calcium salt and the normal utilization and elimination of calcium salts does not take place.

A sluggish liver is commonly associated with this type of arthritis as seen by the very low phosphorus ratio. On a mixed diet there is usually a depressed alkalinity, a low potassium level and a very high chlorine retention if sodium chloride is average in the diet.

To Normalize: In this type the total phosphorus must be raised. This calls for good liver function and may necessitate the use of bile. The protein intake must be high. The calcium foods should be low until most of the calcium deposits have been absorbed. If a high protein diet is not possible, sodium acid phosphate can be used as a laxative as constipation usually is troublesome with this type of arthritis. Soft drinks which usually contain potassium acid phosphate could be used if constipation is not a factor.

The hypotrophic type of arthritis is found in the two following chemical relationships:

(a) A low calcium—high phosphorus and
(b) A low calcium—low phosphorus balance.

This type of arthritis is associated with the removal of calcium from the articulation.

In the low calcium—high phosphorus balance we usually see a low calcium, high phosphorus type of diet plus a high consumption of fats and oils. Such chemistry tends to pull calcium out of the body.

The low calcium—low phosphorus relationship frequently is found in those on a vegetarian type of diet with low meat and milk and a medium to high fat and oil consumption. In such a diet, the assimilation of both calcium and phosphorus is below the natural body loss for these elements and as a result there is a gradual loss of the bone-building elements from the body.

To Normalize: In the hypotrophic type the calcium foods must be high. It is always wise to take sunbaths or a concentrate of Vitamin D and if the basal metabolic rate is quite negative it should be corrected. Every effort should be made to secure good calcium assimilation. Fats and oils should be medium to low. The amount of phosphorus food will depend upon the case. It would be wise to run phosphorus tests to establish the level so the intake can be controlled.

RHEUMATISM AND NEURITIS

Rheumatism and neuritis usually have a different etiology than arthritis. In arthritis the chief chemical disturbance is in the calcium—phosphorus balance. In rheumatism and neuritis we are concerned with the irritability of the motor and sensory nerves. Bacterial or chemical irritants give an over-stimulation to the nerves controlling muscles causing spasticity or stiffness, or in the case of sensory nerves, the sensation of pain. The elimination of any factors that cause nerve irritation and an increase in the factors having a sedative or quieting effect on the nervous system makes for a correction.

Some of the factors responsible for nerve irritation are: infections of any character in the body, absorption of toxic wastes from the colon and the presence of unoxidized organic acids from fruits or vegetables. The irritating factor must be located and eliminated if permanent relief is to be secured. The quieting or sedative forces, as calcium and Vitamin B, should be brought into play, especially if they are low.

In making a correction it is difficult to state all the forces and factors that may be involved: such as assimilation and elimination, or anything that may effect the chemical and toxic levels of the body. Any kidney difficulty, liver dysfunction or a low basal metabolic rate are factors in the case.

To use sedatives without making an honest effort to locate the irritant is to approach the problem from the wrong end.

NERVOUS BREAKDOWN

Nervous breakdowns have been attributed to overwork by some, yet our observations show excessive worry and light physical work or activity give the usual setting that makes this condition possible. The patient usually is out of balance chemically, which increases the tendency for or makes possible the nerve depletion. This may be due to low intake, poor assimilation or a failure to hold calcium because of a high fat, potassium or magnesium intake. A wrong mental attitude also plays an important role.

To Normalize: Keep calcium high and adjust the body chemistry so there is the minimum amount of systemic disturbance. The amount of physical activity should be increased to a point where the patient is really physically tired each day. The mental attitude must be changed and a better philosophy of life developed.

CARCINOMA

Ten years ago we were stimulated to make a chemical study on carcinoma patients after seeing a number of distressing cases. At that time I was led to believe that deep-seated cancer had its origin in a very sluggish or torpid liver with a marked retention of waste products which caused usually an acidosis. The dietary habits or assimilation of the individual was such as to cause depleted mineral levels in the body. The energy food generally was secured from refined cereal starch which was consumed usually in quantity. Coffee, which has a liver checking action, was often high in the diet. Briefly the background is a sluggish liver with a marked retention of body waste products coupled with depleted mineral and probably vitamin levels.

The chemistry of skin cancer is not the same as deep-seated carcinoma. The liver function as far as fat assimilation is concerned seems normal.

To Normalize: Eliminate coffee and all forms of refined cereals. Secure liver function with suitable bile products. A diet schedule containing food high in minerals is indicated. This usually can be accomplished by prescribing a well balanced diet including meat, milk and vegetables. The diet should be low in energy foods as sugar and cereal starch. It would be wise to prohibit all pie and pastry and emphasize fruit and non-cereal puddings like custard and tapioca for dessert.

While no implications are made that cancer can be cured by changing the chemistry of the subject, yet the improved chemical balance seems to increase the resistance and strength of the patient and better fits him for any surgical procedure. We also observed that there seems to be some reduction in the rate of growth of the neoplasm.

Enlarged Tonsils

Statistics show that one-third of all operations in the United States is for the removal of tonsils and adenoids. Any suggestions leading to a reduction in the number of these operations certainly would be worth while. In checking the condition of the teeth and gums the general mouth health including the tone of the mucous membranes and the condition of the tonsils has always been considered. The size of the tonsils is not static but increases and decreases as the chemistry of the body and the saliva varies.

If a suitable alkalinity and good mucous membrane tone of the mouth and throat can be maintained with a low bacterial flora, the tonsils will not enlarge or become infected.

The alkalinity is maintained by the type of food plus liver, kidney and thyroid function. The tone of the tissues is largely controlled by maintaining suitable alkalinity of the mouth plus Vitamin A.

A low bacterial flora in the mouth can be maintained by allowing no refined cereal starch to be fed. All cereals should be the one hundred per cent whole grain product. This will guarantee a high Vitamin B level and in turn a high ptyalin level which is necessary to immediately break down to sugar any starch residue. Sugar is soluble and will be washed away by the saliva before bacteria can act upon it to produce acid and irritating products.

POOR APPETITE

A poor appetite is associated with a number of factors such as a low Vitamin B level, too high a fat and oil intake or a diet too high in sweets, pastry and cereals. Constipation also is a contributing cause. We might add several other factors as the amount of exercise taken or tobacco or liquor consumed. A careful history is often necessary to locate the factor or factors responsible for a lack of interest in food.

INSOMNIA

Insomnia has its basis in a wrong mental attitude, poor sleeping habits and in wrong body chemistry. The tendency to take the family problems and worries to bed to be discussed and thought about is entirely too common. Having no definite retiring time or for social or other reasons varying bed time makes sleeping difficult. Then, we have those who take an emotional book, the latest thriller, to bed for a quiet bit of relaxation before sleep overtakes them and then they wonder why getting to sleep is so difficult.

When pain or physical discomfort is not a factor the body chemistry can be of extreme importance in satisfactory rest and sleep. We find a high calcium level promotes relaxation and is quite conducive to rest. When there is poor chlorine retention or the urine is too acid or alkaline there usually is poor water retention and the rest is broken at night by the necessity for frequent urination.

If a suitable diagnosis is made of the reasons back of insomnia most subjects can, with cooperation, develop satisfactory sleeping habits.

FREQUENT URINATION

Eliminating specific infections of a general or local character, frequent urination usually can be traced to one of the four following causes: too acid a urine; too alkaline a urine; a disturbed water balance and the use of tea in the diet.

An acid urine usually is brought about by too high a percentage of acid foods plus too high an intake of fats and oils which whip up phosphorus assimilation.

An alkaline urine is caused usually by too alkaline a diet consisting largely of fruit and vegetables with little meat and eggs, or a sluggish or torpid liver which interferes with the elimination of acid wastes.

A disturbed water balance causing frequent urination may be brought about by a low intake of sodium chloride plus a high consumption of potassium foods like fruit and vegetable juice and too much fat and oil.

Tea seems to cause bladder irritation in some individuals and may have to be eliminated from the diet.

In addition to the above mentioned reasons, urination at night may be aggravated by drinking liquid just before retiring.

HEADACHES

The causes of headaches are many and varied. Infections in the body are a common cause. The infection may be any place and far removed from the head. Indigestion from too low a hydrochloric acid level, poor liver function and poor pancreatic function are causes. Constipation is a common cause. A calcium level that is too low may increase the susceptibility or chance for an attack. Deficiencies in Vitamins A, B and D are indirect causes in some cases. High and low blood pressure as well as a low basal metabolic rate may cause severe headaches. Headaches occur from an acetone acidosis when the body is burning fats without sufficient carbohydrates. Then there are headaches due to shock and those brought on by high emotional states.

If headaches occur at frequent intervals the cause should be located if possible and the appropriate correction applied. The cause of some headaches is difficult to locate. Fortunately, the vast majority yield readily to correct therapy based upon a correct diagnosis.

ANEMIA

Our chemical data on pernicious anemia cases is too limited to draw any conclusions except to state we found their reactions too alkaline and the retention level of chlorine was extremely low. This meant an alkalosis with achlorhydria.

Simple anemia on the other hand seems to be a very common condition if our tests are any indication. The cases seem to divide themselves into those that ingest too little iron and those who fail to assimilate this element on adequate exposure. The number of cases with anemia that consume an insufficient amount of iron is probably less than those due to a failure in assimilation.

The important assimilation factors seem to be: first, the level of hydrochloric acid; second, the level of calcium; and third, the level of copper. Their importance is probably in the order mentioned. There are without doubt other factors of considerable importance that are now obscure. Iron is soluble only in an acid reaction. It also cannot pass through the intestinal wall unless it is in solution. A normal hydrochloric acid level is important if good iron assimilation is to be maintained. A low fat, low potassium and high sodium chloride level are the essential factors governing the maintenance of a normal hydrochloric acid level in the stomach.

The importance of calcium usually is not appreciated in anemia. It has been established without doubt that calcium is a catalyst for iron. Any factors, such as Ultra Violet light, Vitamin D and a normal hydrochloric acid level, which increase calcium assimilation usually increase iron assimilation.

In simple anemia the feeding of a generous amount of liver is a wise procedure as this product is not only a rich source of iron but of copper as well. The Vitamin A which liver contains is a very probable factor in increasing hemoglobin.

In general the type of diet that prevents simple anemia is one high in lean meat with some glandular cuts like liver. It includes eggs, whole grain cereals and green leafy vegetables either raw as in salads or in the cooked form. Care must be used to prevent the diet from becoming too vegetarian as a high potassium level will tend to lower the hydrochloric acid. In general, fruit and vegetable juice should be out of the diet. Also, all types of fats and oils must be kept low.

DIABETES MELLITUS

The following is the chemistry found in a severe diabetic case: A depressed alkalinity, the potassium from medium to low depending upon the diet, the calcium may be high or low as the intake and assimilation varies, the chlorine tends to be medium to high, the phosphorus medium to low, fat assimilation medium to very poor. Vitamins A and B are low. Vitamin C depends upon the intake. Vitamin D usually is low if taken by mouth, but may be adequate if secured by sunbaths. There usually is acetone in the urine. There may or may not be demonstrable sugar present in the urine. The specific gravity is usually high for the mineral level. The stool tends to be too acid if the patient is not under treatment or on a special diet.

There is a definite balance between the pancreas and the liver. If the pancreatice function is increased by Vitamin B, the liver function will be lowered correspondingly. The reverse also is true. If the liver function is raised by whole bile or bile salts the pancreatice function will be decreased. These differences can be seen readily by observing the phosphorus ratio and the starch digestion test.

In dealing with diabetes it would seem to be essential to determine the relative function of both the pancreas and liver so a proper balance can be secured between these two glands. To give insulin, Vitamin B or pancreatin to a diabetic with a sluggish liver may succeed in reducing blood sugar and eliminating acetone from the urine, but normal function cannot be secured in this way as the liver function will be depressed still further. It would seem that the logical approach to correcting a diabetic condition would be to establish the relative function of both pancreas and liver so support can be given in such a way as to secure balanced function between the two glands.

Tuberculosis

In tuberculosis we are dealing generally with a chronic infection, a lowered body resistance and a disturbed chemistry. The reaction varies from excessive alkalinity to excessive acidity. The calcium usually is very low although occasionally normal. The phosphorus is frequently low, but is normal at times. The phosphorus ratio, which indicates the assimilation of fats, varies from low to high. The greatest disturbance seems to be in the calcium-phosphorus balance in which calcium and phosphorus tend to be very low.

Cases usually respond nicely to an improved body chemistry with special emphasis on the levels of calcium and phosphorus. Vitamin C also tends to be quite deficient. This we feel should be supplied by giant doses of the synthetic product rather than from citrus juice as the high potassium in the latter product would seriously interfere with calcium retention.

PREGNANCY

Early in pregnancy there is very little change observed in the body chemistry. As the case advances from month to month the capacity to eliminate toxic wastes decreases. This can be seen by a marked reduction in the phosphorus ratio from about the fifth month on to the completion of term. This indicates a reduced capacity to assimilate fats and necessitates an increased intake of fats and oils during the latter part of pregnancy. The tests and such symptons as nausea indicate that a high carbohydrate and low fat program is indicated in early pregnancy while a low carbohydrate and high fat intake is advisable in late pregnancy. It often is wise to eliminate all cereal or grain food from the diet by the fifth month depending upon potatoes and bananas to supply the needed carbohydrate. Cereals always are more difficult to handle by anyone with a reduced liver capacity which is decidedly the case in the latter part of pregnancy.

At this period of pregnancy there is poor elimination of wastes through the kidneys and therefore, a tendency for an acidosis. The elimination of all foods, as cereals, that increase toxic waste products is indicated. If on increasing the fat and oil intake the phosphorus ratio cannot be increased to normal there seems to be no reason why the liver cannot be supported with whole bile or bile salts. This would tend to solve the constipation problem, reduce high blood pressure and tend to eliminate the acidosis as well as help establish a normal calcium-phosphorus balance.

The consistent use of sea kelp usually will help prevent the formation of a goiter. This product, due to its Vitamin E content will help prevent still births and enables many women subject to abortion to carry their pregnancies on to full term.

MENSTRUAL DIFFICULTIES

A scant or prolonged menstruation with or without cramps usually can be corrected by suitable doses of Vitamin E. Delayed or irregular menstruation usually responds to the same therapy. Where there is gonadal insufficiency we expect a subnormal temperature. There is a definite inter-relation between the thyroid and gonads. When a deficient thyroid function is normalized by suitable medication gonadal function usually is stimulated also. We find sea kelp a very ideal product as it is high in Vitamin E and has a high percentage of iodine. In cases with subnormal pulse and subnormal temperature we find sea kelp usually raises the temperature faster than the pulse, in fact, quite frequently as the temperature is forced upward by the kelp the pulse rate is actually lowered. In such cases and in those where the pulse rate rises too slowly a small amount of thyroid will pick up the pulse and a more normal relationship can be secured. When indicated, kelp and thyroid given together are more effective in securing a correction than either one of the above elements alone.

QUANTITY AND COLOR OF HAIR

Probably the most important elements entering into the composition of hair are silicon, sulphur, calcium and iron. The circulation or blood supply to the scalp is probably the most important single factor controlling the quantity of hair. A loose, soft scalp seems to be necessary for a good head of hair. Patients who have had a high blood pressure for many years usually have a much better head of hair than those with a low blood pressure. Subjects who are hypothyroid or are quite vegetarian in their dietary habits are inclined to have low blood pressure and are deficient in the quantity of hair. Wearing the hair long increases the warmth of the scalp and together with the extra pull on the hair in the brushing tends to increase the circulation to the area. Congestion or toxic waste products occurring during severe sicknesses tend to cause a loss of hair.

The use of carotene, as found in raw carrots, increases the softness of the scalp and hair and the amount of sebum stimulated by carotene increases the gloss and sheen of the hair. There is very definitely an endocrine and probably a vitamin factor involved in the quantity and quality of hair carried by an individual.

The color of the hair is due to its physical character and composition. Whiteness of hair is caused by a decrease in iron and an increase in the calcium and vacuoles of the hair shaft. Subjects with a high hydrochloric acid level of the stomach with good iron assimilation are more prone to have dark hair. The race and family inheritance are of great importance in the color of hair.

Cataracts

On an average, patients with cataracts seem to have good calcium assimilation and retention but have a low phosphorus level. This seems to be due to a high hydrochloric acid level which increases calcium assimilation with not enough phosphorus to mobilize the calcium so it can be removed. The Vitamins A and B Complex tend to be low. A slightly restricted calcium intake, a high phosphorus level together with a generous intake of carotene and Vitamin B Complex seems to be a helpful procedure. There is often poor liver function in this class of case. Either bile or an acid phosphate can be given to increase the phosphorus level which is essential to mobilize and remove calcium.

BRITTLE FINGERNAILS

Silicon, calcium and sulphur are the principal ingredients in the structure of the nails. Silicon seems to make for bulk, calcium for hardness and sulphur for toughness. Calcium and sulphur are more inclined to be short than silicon. We find when the nails are thin and bend readily but do not break, a raise in the calcium level tends to correct the difficulty. A nail of sufficient thickness and hardness but lacking in toughness is improved by an incease in sulphur foods. In general the consumption of three to four glasses of milk and one egg per day usually guarantees good quality fingernails provided there is good assimilation of calcium and sulphur.

It must be borne in mind that it takes on an average of from three to four months to grow fingernails and six to seven months for a thumbnail. A complete new nail will have to be grown before a change is noticed as there is no natural way to change the quality or structure of a nail after it is formed.

The use of nail polish remover is a factor in brittle fingernails.

STOMACH AND INTESTINAL GAS

Eliminating gas-forming foods as onions, radishes, turnips, yams, parsnips, baked and lima beans, lettuce hearts and sugar from consideration, the cause of gas in the stomach or intestines usually can be traced to too acid or alkaline a stool, too high or low a hydrochloric acid level of the stomach, disturbed liver or pancreatic function, or to infections like appendicitis.

Stomach gas usually is due to too much or too little hydrochloric acid. Rapid eating, of course, contributes to the condition. If the gas occurs immediately after swallowing the food the hydrochloric acid usually is too high. If the gas formation is delayed from one to several hours or is present on arising in the morning there is probably a deficiency of hydrochloric acid. The blood or saliva chloride is a very accurate way of establishing the acid level.

To raise the hydrochloric acid, increase the intake of sodium chloride and greatly restrict potassium and all fatty and oily foods. An increase in sodium foods is helpful.

To lower hydrochloric acid make sure there is good liver function, then increase fats and potassium foods and lower sodium foods like sodium chloride.

Intestinal gas can be due to too low a hydrochloric acid level and to disturbed liver and pancreatic function. If the diet is reasonably balanced these factors control the reaction of the lower bowel. A low hydrochloric acid or a sluggish liver or an overactive pancreas makes for an alkaline stool.

A high hydrochloric acid, a very active liver or an underactive pancreas makes for an acid stool.

By using the stool as an index and keeping it in the range of pH 6.8 to 7.0 most gas cases can be controlled provided the hydrochloric acid, the liver and pancreatic functions are known. To control either stomach or intestinal gas there must be tests designed to show the function of the major glands concerned in digestion.

ALCOHOLISM

The influence of alcohol on the body chemistry is not generally known. When taken in the form of liquor the effect upon the chemistry will depend upon the percentage of alcohol and the nature of the products. In high alcoholic liquors like whisky there is an acidosis produced due to the kidney checking action of alcohol. There is a rise in the retention levels of phosphorus, chlorine, calcium, etc., and a depression in the alkalinity due to a failure to eliminate acid waste products.

Beer, while having a low alcoholic content, is decidedly acid forming due to the nature of the product. All grain products are acid forming due to their acid ash and any non-distilled product made from grain is bound to be acid forming. Beer greatly increases the phosphorus level of the body and depresses the alkalinity as well as encouraging the loss of calcium through the urine.

Wine, provided the alcohol content is low, has an alkaline reaction in the body due to its alkaline ash. Light wines, either sour or sweet, will increase the alkaline and potassium levels of the body. On the other hand, reinforced wines increase the acidity of the body due to the alcohol content.

An acidosis is to be expected in alcoholism. Because considerable alcohol can be burned in the body as an energy food, the consumption of normal foods decreases, so there is usually a mineral and vitamin deficiency. Alcoholic neuritis is attributed to a deficiency of Vitamin B and will usually respond to that therapy.

EFFECT OF TOBACCO

Tobacco is acid forming and will throw the reaction of the saliva toward the acid side. Because of the marked increase in mouth acidity due to heavy smoking, the use of tobacco in any appreciable amount will increase the incident of dental decay as well as lower the tone of the mucous membrane.

The chances of a serious Vincent's infection are always greater when the mouth is acid and the mucous membrane tone depressed. Observations on hundreds of cases have revealed that the average smoker cannot exceed one-half pack or ten cigarettes a day without causing a marked depression in the reaction of the saliva. There are a few persons who can smoke as high as twenty cigarettes per day and still maintain fair mouth alkalinity, but the number is relatively few. For the average person who is anxious to maintain good oral health the amount of smoking must be kept within the above stated limits.

MUSCLE TONE

Aside from exercise, which is essential for good muscle tone, there are a number of other important factors. Among these is the amount of animal protein in the diet, the level of potassium and sodium, the level of calcium and the percentage of toxic waste products that is being produced.

It is generally conceded that a fairly generous protein intake is necessary for good muscle tone. The type of diet fed at training tables where athletes prepare for a contest bears out this thought. You cannot make muscle unless you feed the essential constituents found in muscle. The amount of potassium in the diet should be within certain limits. It has been known in an academic way for some time that potassium causes muscles to relax. When the amount of potassium is too high there is a tendency for over-relaxation and poor muscle tone. The average vegetarian exhibits this to a marked degree.

Calcium and sodium on the other hand cause muscles to contract. Good nerve stability is essential for muscle tone. Athletes must and usually do have a stable nervous system. Calcium is one of the most important factors in muscle tone.

Toxic and irritating waste products in the body irritate the nervous system. This in turn often over-stimulates the muscles causing spasticity. Muscular rheumatism, stiff neck and asthmatic attacks are illustrations. There is a tendency for muscles to be stimulated to the point of stiffness when toxic products are permitted to accumulate.

INTESTINAL RATES

The average intestinal rate in the prime of life probably is between 24 and 36 hours. Children have shorter rates and the aged very much longer rates. We believe from 24 to 36 hours is a satisfactory adult intestinal rate. This rate gives sufficient time for all necessary steps in digestion and elimination to take place.

There are many factors that govern the intestinal rate: as the amount of residue in the diet, the amount of liquid, the fat and oil intake, sodium chloride level, the amount of calcium foods, the presence of a spastic or atonic colon, liver function, adhesions or abdominal operations, nervous instability, Vitamin B level and the amount of abdominal exercise.

We will comment briefly on the above factors. An increase in residue and liquid together with an increase in sodium chloride and Vitamin B and exercise tends to increase intestinal rates. An increase in fats and oils and calcium foods together with conditions like spastic and atonic colons and adhesions tends to slow down the rate.

While a sluggish liver usually slows down the intestinal rate, in rare cases the rate is increased. High emotional states usually increase but can at times decrease the rate.

DIARRHEA

When not due to an infection any marked or radical change in any of the factors discussed under "Intestinal Rates" may cause diarrhea or constipation depending upon the direction of the change. Most liquid stools are acid.

ANGINA PECTORIS

In the few cases we have had an opportunity to check there seems to be fewer attacks when the blood pressure is kept reasonably high, when sodium chloride is kept high and fats and oils and potassium foods low. When Vitamin B and the calcium level is raised there seems to be a definite improvement in the symptoms. A lower altitude seems to be better than a high one.

EPILEPSY

Epilepsy is attributed to an over-production of natural insulin or to too high an internal pressure on the nervous system or both. In the light of our tests and observations on this type of case the following dietary program seems to be helpful. A high fat and oil and calcium intake coupled with a low sodium chloride. The potassium food should be high and carbohydrates, as sugar, readily available in case of threatened attack. Vitamin B foods, as whole wheat bread, asparagus and avocados, should be restricted. In case of a sluggish liver it would seem that bile would be indicated. The use of coffee which checks liver function would seem to be contraindicated.

BONE FRACTURES

In bone fractures that fail to heal there are several possible causes such as infections in the area that will have to be cleared up and a faulty calcium-phosphorus balance. There are many factors that affect the level of calcium and phosphorus aside from quantity. We find the Vitamin D level, the basal rate and hydrochloric acid level among the most important. How important Vitamin C is to bone regeneration is difficult to say as only one or two per cent of the population in Southern California are definitely short.

KIDNEY STONES

The composition of kidney stones is principally calcium phosphate. It is generally considered that a dead cell or organic matter of some character is necessary to form the matrix for lime salt deposition. Be that as it may, there probably will not be a kidney stone if the urine is definitely acid. In every case of kidney stones the urine has been alkaline, which is the reaction necessary for kidney stone formation. In the removal of kidney stones without surgery the urine must be made extremely acid to accomplish the purpose. No vitamins or other factors seem to be necessary for placing calcium phosphate into solution other than an acid reaction. Kidney stones seem to be associated with a sluggish or torpid liver, a condition that tends to produce quite an alkaline urine. When the liver is shown to be sluggish the use of bile salts coupled with an acid forming diet consisting of generous amounts of meat, fish and possibly cereals will furnish the necessary amount of acidity. Potassium or sodium acid phosphate can be taken when necessary to furnish the necessary amount of acidity. It is doubtful whether a greater acidity than pH 5.0 should be attempted. A fairly generous amount of light fats and oils will increase greatly the amount of phosphorus assimilated. Cottonseed oil usually is well tolerated and has been found effective. When the Roentgenograms show the calcarious material has been removed, the extremely high phosphorus and acid urine should be discontinued as pyorrhea may be induced.

GALL STONES

The forces and factors necessary for the formation of gall stones are not the same as those responsible for kidney stones although some of the factors seem to be the same. Probably gall stones are intimately connected with a gall bladder infection. The fact that the gall stones consist largely of cholesterol and that the level of Vitamin A in the body governs to a large degree the level of cholesterol in the blood stream and saliva must be remembered. Vitamin A seems to govern the utilization of cholesterol.

When gall stones are present we usually have a sluggish liver with an insufficient amount of bile. It seems that the syndrome necessary for the formation of gall stones is an infected gall bladder, a sluggish liver plus a deficiency in Vitamin A or carotene. The therapy indicated seems to be the use of light fats and oils and whole bile or bile salts together with carotene or Vitamin A.

EAR NOISES

There are several common factors responsible for ear noises of one type or another. The closure of the eustachian tubes due to swelling of the mucous membrane is often responsible for a roaring noise. A tendency for catarrhal difficulty or sinus trouble is usually associated with this condition. When urates appear in the urine or an alkaline stool is present we expect poor mucous membrane tone. This type is controlled by high sodium chloride, low fats and potassium foods with high Vitamin A.

There is another type of ear disturbance that is quite annoying and that is a "ticking noise." This is usually brought about by a low calcium level. When a good lime level is secured, complete relief from this condition generally is the result. Vitamin A, which controls to a marked degree epithelial tone, may be a factor.

CHAPTER

VII

EXPLANATION AND INTERPRETATION OF CHEMICAL LEVELS

pH AND BUFFER VALUES

(By the use of the LaMotte 3B Colorimetric Hydrogen Ion Set.)

SALIVA DETERMINATION

1. The actual pH is read about one minute after adding indicator to the sample. During this minute the sample should be agitated constantly to mix. The saliva mucin makes rapid mixing difficult. This reading shows the sum total of all the H^+ and OH^- ions in the solution. The actual pH secured by this method compares favorably with that secured by the use of the potentiometer or electrical method.

2. Another true pH reading is made after the saliva has stood for one hour in the presence of air to permit a CO_2 equilibrium

to take place before the indicator is added. The fresh saliva usually contains more CO_2 than is found in the air, so the pH reading made at the end of one hour is usually more alkaline than one made immediately on a fresh sample. The reading must be made immediately after adding the indicator. This reaction is the pH of the saliva less the influence of CO_2.

3. The buffer value is secured by permitting the saliva to stand for one hour in the presence of the indicator. Inasmuch as all indicators in the alkaline range are weak organic acids, the pH shown by this method is the amount of ionizable alkaline salts that can combine with the indicator at room temperature in one hour. The warmer the room the more rapidly the sample reaches the end point. Very few samples will show any pH change after one hour. When that does occur it is usually in cold weather which delays or slows down chemical reactions.

Saliva samples that have stood 24 hours or more in the refrigerator will have a more alkaline pH due to the loss of CO_2 gas. The buffer value of these samples, however, is the same as on fresh samples.

Saliva samples vary considerably in the amount they rise on standing. Two fresh specimens may start at the same pH and one may rise 5 points while the other may rise 10 points. In about one in a thousand cases a sample may be more acid by a point after standing one hour than the original reading. There seems to be a definite relationship between the amount of rise or the buffer value and the general physical health or resistance. It is a good sign as to the patient's well being when there is a marked rise on standing.

4. Comparative studies on the buffer value secured by the above method tend to run parallel with electrical titration. While the electrical titration gives more alkaline values than the value secured by the colorimetric method held for one

hour, the difference seems to be uniform. In one series of tests the difference was pH 0.4. It is our contention that the buffer value shown by the colorimetric method is not the complete or full buffer value. The values secured at room or blood temperature do not record or show the full potential buffer possibilities. Only in some forced method like that of electrical titration can the full buffer value be demonstrated.

We also feel that the buffer value secured at room temperature by the colorimetric method is nearer to the buffer possibilities occuring in the mouth when the soluble ionizable alkaline salts of the saliva neutralize the acids of fermentation. An additional advantage of the colorimetric method over the electrical is that the buffer value can be shown on one drop of solution.

5. There is a definite relationship between the buffer value of the saliva and the phosphorus level of that secretion. As the phosphorus increases, the buffer value is made increasingly more acid. We have established that the saliva phosphorus level of 0.150 milligrams per c.c. should on an average give a pH of 7.8, while a phosphorus level of 0.186 milligrams should give a pH of 7.6. (See table on page 44.) This allows for the average interference from H^+ and OH^- ions; from inorganic sulphur compounds and organic acids like benzoic and oxalic; as well as the acid products like acetone which result from the incomplete splitting of fats.

6. If it is found that the pH is depressed below the expected value for a given phosphorus level, every effort should be made to eliminate or reduce the interference. This may call for a reduction in high sulphur foods like mustard or eggs or a reduction of foods high in organic acids like cranberries, prunes, oranges, grapefruit and tomatoes or a marked reduction in the amount of fats and oils.

7. It has been found that when the hydrochloric acid of the stomach is low or the basal metabolic rate is low or both conditions are present, there usually is some difficulty in breaking down the organic acids found in fruit. This calls for a reduction in the offending acid until the disturbed chemistry can be overcome.

8. Smoking also depresses the alkalinity of the saliva. It has been found that ½ pack or 10 cigarettes is the limit that can be smoked per day by the average person without seriously depressing the saliva alkalinity.

9. Adverse emotional states like fear, worry, fright or anger cause a marked reduction in the alkalinity of the body as shown by a depression in the saliva alkalinity. If suitable alkalinity of the body is to be secured, adverse mental attitudes must be eliminated. A state of dental decay can be caused almost entirely by prolonged periods of fear or worry.

10. Exercise to the point of perspiration usually increases saliva alkalinity by causing a loss of acidity through the pores of the skin.

Urine Determination

1. The urine pH and buffer values are secured by the same technique used for saliva.

2. The amount of buffer in the urine is very low compared to saliva. In urines ranging between 5.0 and 6.0 pH, we expect no change in standing or at the most a .1 point rise. In urines with a pH between 6.0 and 7.0 pH, a rise of .2 points is usual. At times we secure a .3 point rise. With urines above pH 7.0 we may secure as much as .6 points or more.

3. It is felt that the average range of a normal urine is from pH 5.8 to 6.0. The buffer range is between 6.0 and 6.2 pH. Slight deviations above or below these figures seem to have no significance.

4. There is a relationship between the urine pH and the phosphorus level. This relationship is not so definite as that found in saliva. Because the kidneys seem to have a selective action with the object of maintaining a normal blood pH the percentage of mono- and dibasic phosphorus salts varies from time to time according to food intake and body activity.

5. The ability of the body to oxidize organic acids derived from vegetables, fruit and the metabolism of fats makes for changes in the urinary pH. A high meat, fish, eggs and cereal diet makes for an acid urine. A high vegetable and fruit intake where metabolism is normal, makes for an alkaline urine. A high fat diet usually increases urinary acidity as fats increase the percentage of phosphorus eliminated in the urine.

STOOL DETERMINATION

1. The actual pH is what is read in stool analysis and this reading must be made at once. Any delay in reading after adding indicator makes for inaccuracy as stools have a high buffer value and rise very rapidly on standing.

2. The pH of the stool is dependent upon a number of factors. Persons with a rapid intestinal rate, say of 12 hours, usually have acid stools. Those with slow intestinal rates tend to have alkaline stools.

3. The character of food governs to a great degree the pH of the stool. Protein tends to give alkaline stools while starch, sugar, fruit and vegetables give acid stools. Human milk gives acid stools due to the high milk sugar content. Sweet cow's milk is inclined to give an alkaline stool while buttermilk gives an acid one.

4. Stools may be acid or alkaline according to the metabolism of persons on fairly well balanced diets. If the hydrochloric acid is low there is a tendency for an alkaline stool. With poor

pancreatic activity, especially as to starch digestion, there is a tendency for an acid stool. Where the amount of bile is below normal an alkaline stool is the rule. Where the percentage of fats is high, the intestinal rate is slowed down and with it a tendency for an alkaline stool follows.

CALCIUM DETERMINATION
(Modified Kramer and Tisdall)

The modified Kramer and Tisdall test for saliva calcium that has been developed checks very closely with the findings secured by standard ashing methods. In 16 determinations run in parallel employing this modification of Kramer and Tisdall's method with a standard ashing technique, only in one case did the difference exceed 0.01 milligrams in the final reading. Such differences are well within a measuring error and show the extreme accuracy of this method.

We always have used whole saliva in preference to the filtered sample. The only reason given by those employing filtration is that it removes food residue and epithelium that might interfere with accuracy. The use of the modified method as discussed above eliminates the necessity for filtration. The use of filtration gives calcium readings very much lower than those secured by an ashing on whole saliva. It must be appreciated that quite a high percentage of calcium in the saliva is in colloidal form too large to pass through a good filter. The fact that the teeth are bathed in whole saliva is sufficient reason for using that type of sample for our determination.

We are desirous of knowing the neutralizing capacity of the saliva. The character of the saliva as it comes from the saliva glands before it has stood too long in the mouth gives us our best index. To reduce to the minimum the influence of the residual saliva it is important to secure a somewhat forced sample and to make it as generous as possible. We try for at least twothirds of an ounce which takes on an average of thirty minutes to obtain. We often use a sterile piece of rounded glass rod about three-fourths of an inch in length and one-fourth of an inch thick to hold under the tongue. This stimulates the salivary flow, but does not change the character of the saliva chemically or physically. The use of paraffine should be avoided as it greatly increases the alkalinity of the sample and makes an accurate pH reading impossible.

The level of calcium in the saliva is dependent upon a number of factors:

1. The amount and character of the calcium in the diet.
2. The buffer pH of the saliva.
3. The amount of phosphorus assimilated.
4. The amount of potassium assimilated.
5. The amount of magnesium assimilated.
6. The basal metabolic rate.
7. The influence of Vitamin D.
8. The rate of growth in the case of a child.
9. The hydrochloric acid level.
10. The amount of bile secreted.
11. The level of iron in the body.
12. Overactivity and underactivity of the parathyroids.
13. The intestinal rate.

1. When an average amount of calcium from milk is being assimilated we find a quart per day suffices for a child and a little better than a pint is necessary for an adult. Three glasses of whole milk, skim milk or buttermilk make a very satisfactory milk allowance for a normal adult. If the hydrochloric acid of the stomach is sufficiently high the type or form of calcium is of minor importance. Either di- or tricalcium phosphate or calcium carbonate is satisfactory. If the hydrochloric acid is low a soluble form of calcium like calcium lactate or calcium

gluconate must be secured. The amount of calcium taken in tablet or powder form should be not less than 1.0 grams per day for a child and not less than 0.7 grams per day for an adult.

During pregnancy one quart of milk is usually sufficient. During lactation one and a half quarts is usually the maximum that need be taken. It must be borne in mind that during pregnancy and to a lesser degree during lactation, the metabolism tends to be at a higher level with improved assimilation.

2. The calcium level of the saliva is more or less dependent upon the buffer pH of that fluid. The more acid the saliva, the greater the salivary calcium level in the same individual. It matters not the cause of the acidity which may be due to an infection, kidney obstruction, high phosphorus or sulphur intake, organic acids like benzoic and oxalic or acetone from faulty splitting of fats. The lower the alkaline reserve in the body the more soluble the calcium becomes, so there is a greater tendency for a loss in both saliva and urine. We therefore expect higher calcium values in saliva and urine as each fluid becomes more acid.

3. The amount of phosphorus governs to a great degree the retention level of calcium. On a high phosphorus intake we would expect an increased calcium loss either in saliva or urine or both. The direction of calcium loss depends usually on the phosphorus level. Calcium and phosphorus levels tend to run parallel due to the great chemical affinity of phosphorus for calcium. Arthritis cases show this nicely. In the hypertrophic type we always have a low phosphorus state, while in the hypotrophic type we expect a very high phosphorus.

4. Potassium leaves the body usually as a potassium phosphate. Because potassium stands at the head of the electromotive or electro-chemical series its power of displacement is high for other basic elements like sodium, calcium and magne-

sium. A high potassium intake usually means a high calcium loss through the urine and a correspondingly lower calcium for the saliva.

5. For a long time magnesium has been known to have the power of displacing calcium. This displacement of calcium by magnesium from food sources is usually not high. Magnesium taken as a laxative has the tendency to depress the alkalinity and the calcium level of the saliva and to increase the alkalinity and calcium level of the urine. This displacement of calcium by a high magnesium intake makes it unwise to use a concentrated magnesium product as a laxative in bone or dental conditions like tooth decay or pyorrhea.

6. The basal metabolic rate influences the assimilation and level of calcium. In inactive or hypothyroid states calcium is not readily assimilated. Tests show both salivary and urinary calcium are low. When the thyroid is over-active, calcium assimilation seems to be good, but there is a marked tendency to lose lime through the urine with a low retention or saliva level. Both hyper- and hypothyroid states tend to cause dental decay.

7. There is no question that Vitamin D increases both calcium and phosphorus assimilation. If Vitamin D is administered by Ultra-violet light or sunbaths, it takes from one to three months for calcium to reach a peak or maximum, and an equal period of time to return to the previous low level on the elimination of the therapy. If Vitamin D is secured by mouth in the form of Cod Liver Oil or one of its concentrates or by use of Viosterol, a calcium peak can usually be secured in about two weeks. On the elimination of the product there is a rapid fall, so in two weeks the previous low level prevails. For quick results Vitamin D by mouth is indicated. For sustained effects, Ultra Violet light is best.

How Vitamin D operates on calcium and phosphorus is not known. The consensus of opinion seems to indicate that this vitamin increases the assimilation of both calcium and phosphorus from the upper end of the small intestine. Our observations seem to indicate that Vitamin D stimulates or increases the production of bile from the liver. Liver function is definitely improved by sunbaths or Ultra Violet light. If whole bile is taken by mouth there is an increase of both calcium and phosphorus in saliva and urine. In other words, the effects of Vitamin D and bile on the body chemistry are very similar—so much so as to be almost startling.

8. Rapid growth is unquestionably a factor in the incident of dental decay. It is also a factor in depleting the mineral levels of the body. When a big demand for calcium and phosphorus occurs, as in the case of rapid growth—a marked fall takes place in the salivary and urinary calcium. When a boy or girl starts a rapid growth period it should be a warning signal to his or her guardians to be on the alert against mineral depletion. It is only with great difficulty that calcium can be maintained during periods of accelerated growth.

9. If we use chlorine retention in either the blood or saliva as an index of the hydrochloric acid level, we will find when chlorine retention is poor, calcium assimilation is usually poor also. So universally is this true that we usually make a desperate effort to raise the hydrochloric acid level before we commit ourselves to a Vitamin D shortage as the most likely assimilation factor unless our test shows this vitamin to be quite deficient.

Our tests seem to sustain the theory that calcium in food is usually converted into the calcium chloride form by the action of hydrochloric acid. It passes to the small intestine to be changed to the insoluble soap, calcium stearate. If bile is present in suitable amounts, this insoluble soap can pass through the intestinal wall. If not, it is eliminated as such through or by means of the stool. A failure in hydrochloric acid or bile will prevent the desired calcium assimilation.

10. As has been previously mentioned, bile is an important step in calcium assimilation. Without a suitable level of bile or liver activity, calcium cannot be assimilated. Calcium shortages are to be expected in all liver cases. If a patient has a history of typhoid fever, malaria or amebic dysentery, there is a strong possibility the liver has been injured from a slight to a marked degree. Phenolphthalein, if taken over a period of time, will cause considerable liver injury. If in addition to having had one of the diseases mentioned the patient is constipated without any apparent cause, or has an aversion to milk or eggs, or is disturbed greatly by their use, or if fats and oils in quantity cause biliousness, there is in all probability a shortage of bile. We find the phosphorus ratio a wonderful index of fat assimilation and fat assimilation is a good index as to the amount of bile present. A ratio of 1 to 1 on a high or normal fat intake indicates an extremely low bile flow. A phosphorus ratio of 1 to 2 in the presence of a liberal fat intake shows a definite shortage. Even a 1 to 2.5 ratio may be regarded with suspicion if marked symptoms indicating a probable shortage are present. The use of whole pig bile when indicated has given excellent phosphorus ratios and calcium values.

11. It is very common to find calcium very low in pronounced cases of simple anemia. Iron seems to act as a catalyst for calcium. Hence, it is important to check the hemoglobin in all cases of low calcium due to poor assimilation.

12. Some years ago we ran a series of tests to measure the influence of parathyroid products on the calcium and phosphorus level of the saliva and urine. We found for a short period following the administration of it, calcium and phosphorus levels were raised. This was followed by a period in which these levels were correspondingly lower. When we realize that the parathyroids mobilize the calcium and phosphorus

from the bones of the body with no probable increase in assimilation of these elements, it does not seem wise to use parathyroid therapy over any extended period of time for fear of depleting the bony skeleton. When the parathyroids are very inactive the amount of calcium and phosphorus mobilized from the bones is too low and it is difficult to maintain suitable blood and saliva levels. Fortunately, the number of such cases seems to be very few.

13. Fast intestinal rates are associated with a tendency for loose acid stools with poor calcium assimilation. Normal intestinal rates for the average adult will run from 24 to 36 hours. In rates as fast as 12 hours we expect poor calcium assimilation and the lime will be lower in the saliva and urine. A marked reduction in the amount of fruit and fruit juice and vegetables and an increase in meat, cheese and eggs will usually slow the rate to normal. The use of powdered beef bone in from ½ to 2 teaspooonful doses will slow down the more refractory cases.

Phosphorus Determination

The phosphorus foods are meat, fish, eggs and seeds of all kinds like cereal and grain foods, nuts, chocolate, condiments (mustard and pepper), peas and beans. Soft drinks and all malt liquors are also high sources.

In the body phosphorus is intimately associated with calcium and potassium and tends to leave the body as a calcium phosphate or a potassium phosphate.

The level of phosphorus governs the pH of the saliva to a marked degree and to a slightly less degree the pH of the urine. All in all there is probably no element or compound that has a greater influence over the salivary and urinary pH than phosphorus. On a mixed diet the presence of phosphorus has a depressing effect on the alkalinity of saliva and urine. Usually the greater the phosphorus the greater the acidity. There are a few exceptions, as where a high alkaline phosphorus source predominates in the diet, as in the case where peas, beans and true nuts are used. In this case a high alkalinity may be possible in the presence of high phosphorus.

The importance of phosphorus in nutrition and in the control of caries and pyorrhea is usually underestimated. We must always remember that about 90% of bones and teeth are made up of calcium phosphate. Phosphorus is just as important in the formation of bones and teeth as is lime (calcium). In fact, in some ways phosphorus is more important than calcium, as in caries in children where a phosphorus deficiency is usually more prevalent than is that of calcium.

It must be borne in mind that while it is possible for calcium to enter the body without the aid of phosphorus, it is next to impossible for it to leave the body without phosphorus. Arthritis cases are good illustrations of this. In the hypertrophic or high calcium-low phosphorus type we have an accumulation of calcium salts in the body in the form of deposits—the calcium in the saliva and urine being low. In the hypotrophic or low calcium-high phosphorus type there is a removal of calcium usually from the articulations. The calcium in the saliva and urine may be and usually is high.

High calcium with low phosphorus is the usual blood balance found in caries in children and in soft gingival decay in adults. Low calcium with high phosphorus is the blood balance found in true erosion in adults.

In pyorrhea we are dealing with three types or balances of calcium and phosphorus:

1. The common or poor gum tone type has a tendency for bleeding, tissue pockets, alveolar absorption and often salivary deposits. This is characterized by a low calcium-high phos-

phorus state. The saliva and urine are usually quite acid with very high phosphorus and a fairly high calcium level.

2. The next type as to frequency is that of low calcium and low phosphorus. The local symptoms are good gum tone, no bleeding, no tissue pockets, no salivary deposits—but with considerable alveolar absorption.

3. The third, which is found very infrequently, is a high calcium and low phosphorus condition. Fairly good gum tone, slight tendency for tissue pockets, heavy salivary deposits and some alveolar absorption is usual.

In securing a normal chemistry the ability to govern the level of phosphorus is often more important than the control of calcium although both are important.

Phosphorus assimilation is usually not so difficult to obtain as that of calcium although at times it is a serious problem. The following is a list of the factors involved in maintaining a suitable phosphorus intake as well as those that involve its assimilation:

1. Sources of phosphorus in the diet.
2. Level of unsatisfied fats in the diet.
3. Hydrochloric acid level.
4. The amount of bile flow.
5. Vitamin D.
6. Amount of pancreatic enzymes.
7. Vitamin B.
8. Presence of infections in the body.
9. Basal Metabolic Rate.

1. The animal sources of phosphorus as meat, fish and eggs are more valuable as a source of this element than are the vegetable forms as grain food, peas, beans and nuts. Experience has shown it is much easier to obtain a suitable phosphorus level from foods of animal origin than from those of the vegetable

kingdom. It is probable that the cellulose found in all vegetable foods acts as a barrier to the release of phosphorus. In herbivorous animals the longer intestinal tract gives more time for the bacteria to work on cellulose and release the phosphorus. The fact remains that the plant kingdom does not offer the average person a readily available source of phosphorus.

2. Food phosphorus does not pass through the intestinal walls readily without the aid of unsatisfied fats and oils. As far as we know, all food phosphorus passes into the circulation as a phospho-lipid, a combination of fat and phosphorus. The unsatisfied valences of the fatty acids act as the attachment points for phosphorus. The inorganic phosphorus as found in some medicinal products and soft drinks seems to be able to pass through the intestinal wall without the aid of fats. An explanation of this is not available. When inorganic phosphorus is taken in quantity the phosphorus ratio is of little or no value as an index for fat and oil assimilation.

3. A suitable hydrochloric acid level is essential for proper protein digestion both in the stomach and in the intestinal tract. Many cases showing low phosphorus on a high intake of these foods are low in hydrochloric acid.

4. The amount of bile secreted is of great importance in phosphorus assimilation as normal fat assimilation cannot take place without bile and phosphorus assimilation is contingent upon fat assimilation. Therefore, a normal bile flow is essential to a normal phosphorus level. In sluggish liver cases the use of whole bile with a suitable intake of fats usually guarantees the ready assimilation of phosphorus.

5. It is generally recognized that Vitamin D stimulates the assimilation of both calcium and phosphorus. In the saliva the increase of calcium is usually much more pronounced than phosphorus on high Vitamin D therapy free from excessive oil. Whether this vitamin is administered by mouth or by ultra

violet rays, there is a definite phosphorus stimulation. We must remember that dental decay in children usually is a high calcium-low phosphorus state as far as the blood is concerned. There is naturally a tendency for the increased phosphorus assimilated to be absorbed internally in normalizing the blood and tissues rather than to cause much change in saliva and urine levels. Vitamin D seems to act in some way through the liver, possibly by stimulating an increase in the amount of bile.

6. The amount and quality of the pancreatic juice is important as it influences markedly the assimilation of phosphorus probably through its protein splitting enzymes. Pancreatin given by mouth in indicated cases gives a definite increase in the level of phosphorus.

7. It is not fully appreciated, but it is a fact, that Vitamin B increases pancreatic function. Without Vitamin B normal pancreatic function and phosphorus assimilation is impossible.

8. In some way infections in the body depress the assimilation of phosphorus. It matters not where these infections are located. An arthritic case with many abscessed teeth with poor phosphorus assimilation will often show a marked improvement in the phosphorus level on complete removal of the infected areas. The evidence seems to indicate that infections depress pancreatic function. In this type of case pancreatin given by mouth in suitable doses tends to offset the ill effects of the infection. Theoretically, Vitamin B_1 should have the same effect.

9. In cases showing very low basal metabolic rates we often see low calcium and low phosphorus values on a suitable intake. These values rise rapidly on the administration of thyroid. The basal rate has a definite influence on the phosphorus level in some cases.

PHOSPHORUS RATIO

The "phosphorus ratio" is secured by dividing the phosphorus level of the saliva into the phosphorus level of the urine. The saliva and urine must be taken on the same day, the saliva at least one hour after a meal and the urine taken from a full night specimen.

Food phosphorus cannot pass through the intestinal wall or be eliminated readily through the kidneys without the aid of unsatisfied fats and oils. The phosphorus ratio can therefore be used as a fairly accurate index of the amounts of the light fats that are being assimilated. This ratio bears no relationship to the total amount of fatty substance ingested as it cannot be increased in cases where liver function is impaired unless bile salts or whole bile is being taken. The ratio shows fat assimilation only, and only when liver function is normal does it bear a relationship to the amount of fats ingested. A phosphorus ratio of 1 to 3 and 1 to 4 is normal. Ratios of 1 to 5 or more are high and call for a reduction, since a high fat consumption as indicated by such ratios causes a high loss of all the minerals through the urine and a corresponding low retention as shown by the saliva level. In some cases high ratios are indicated, as when it is desirable to reduce the retention level of the minerals or of the vitamins which seem to follow the same rule or law. Any index like the "phosphorus ratio" that can show at a glance the tendency to lose or retain minerals, is of great value in diet regulation and in metabolic studies.

Strict mineral forms of phosphorus not associated with protein can pass through the intestinal wall without the aid of fats and oils. I refer to sodium acid phosphate as used in some laxatives and potassium acid phosphate used in soft drinks. These strictly mineral forms of phosphorus should be eliminated from the diet when tests are being run as the phosphorus ratio cannot be established accurately in their presence.

In some cases where the "phosphorus ratio" shows the liver function impaired, it is not wise to use bile or bile salts; especially is this true in asthma cases. While most allergic cases have high ratios that call for a reduction, yet the use of any measures that would stimulate liver function in a minerally depleted subject is fraught with grave consequences. In some cases of hay fever with liver impairment and alkaline stools, a small amount of bile just sufficient to acidulate the stool can be given.

When a generous amount of fat is being consumed in an impaired liver case, we often have ratios of 1 to 1 or even lower. Such values in the presence of a generous intake of fat or oil indicate extremes of liver impairment and almost always call for the use of bile in some form. If a subject can develop a ratio of 1 to 2.5 on a generous fat intake, it shows some liver impairment, but does not always call for the use of bile unless the symptoms—as alkaline stool with constipation and poor calcium and phosphorus assimilation—require improved function. There are other conditions that may call for improved liver function, as high blood pressure, edema, or a high hydrochloric acid level accompanied by ulcers.

There are many who suffer from frequent bilious attacks. In all such cases impaired liver function with low phosphorus ratios is to be expected. The condition may be aggravated by the consumption of coffee, chocolate, eggs or a high fat diet. In mild cases of liver dysfunction, a freedom from symptoms and a fair degree of comfort may be secured by the elimination of the above offending foods. Sunbaths seem to stimulate liver function and during attacks the use of hydrochloric acid is quite often helpful.

The consistent use of the "phosphorus ratio" is a valuable aid in diet regulation as well as in metabolic studies.

POTASSIUM DETERMINATION

The amount of potassium assimilated and eliminated from the body is dependent largely upon the element phosphorus. When phosphorus is high in the saliva or urine it is possible for potassium to be high and when the phosphorus is very low in the saliva or urine, the potassium is always low. It is possible for potassium to vary according to the percentage of mono- or dibasic phosphorus salt present. To state it in a different way, when phosphorus is high we expect from a medium to high potassium, hardly ever low. When phosphorus is low the potassium varies from medium to low, never high.

On a mixed diet the percentage of monobasic potassium phosphate predominates over the dibasic form. This can be shown to be true, for when potassium phosphate increases in the saliva and urine, there is a depression of the alkalinity as shown by the hydrogen ion test. Potassium is largely consumed in changing phosphoric acid to a monobasic salt with little or no surplus or opportunity for the formation of a dibasic potassium phosphate. It is more than likely that a less basic element or chemical grouping than potassium is more directly responsible for the production of the OH ions necessary to maintain the alkalinity of the body.

Potassium has a very marked effect usually on the other basic elements and on some acid radicals. The effect of potassium upon calcium is a good example. When fruit juice or any other high potassium food is consumed in quantity there is a fall of calcium in the saliva and an increase in the urine. It is next to impossible to hold the saliva calcium up in the face of a high potassium intake. An increased loss through the urine of two or three times the normal can often be seen due to this displacing action. Potassium must be under control if we hope to maintain a normal calcium level. A maximum potassium concentration of 1.0 milligrams per c.c. in the saliva and 2.5 milligrams total for saliva and urine is about normal and sufficiently low to make for good calcium retention as far as this element is concerned.

Sodium can also be displaced by potassium when the latter is in high concentration. When sodium is lost by a high potassium or fat intake there is a reduction of chlorine in the saliva and a marked increase in the urine. The retention of sodium is necessary for good chlorine retention. Because of the extreme chemical activity of potassium the intake must be under strict control.

Many find it difficult to keep potassium sufficiently low due to our modern diet trends. A list of the very high potassium foods might not be amiss.

The following foods are high in potassium: Vegetables and vegetable juice, fruit and fruit juice, beans, nuts, chocolate, dried fruit, molasses, spinach, potatoes, wheat bran, soft drinks, wine, vegetarian salt, olives, paprika.

In a normal chemistry there is always a higher percentage of potassium in the urine than in the saliva. If we should care to develop a potassium ratio the normal would be from 1 to 1.5 to 1 to 2 or should be just one-half the phosphorus ratio. Occasionally an inverse ratio is found, and while this is uncommon, no mistake has been made in the chemistry.

CHLORINE DETERMINATION

The chlorine level of the saliva is an accurate index of the blood chlorine level and runs parallel with it, although the values are not the same. The saliva chlorine runs much lower than the corresponding blood level. The blood chlorine tends to run parallel with the hydrochloric acid of the stomach and is probably more accurate than stomach pump determinations.

We find the saliva chlorine to be a wonderful index of the hydrochloric acid level and checks very closely with the clinical picture.

Because the saliva chlorine shows the retention, but not the total intake, many low and high blood pressure cases can be explained and helped by it.

The level of chlorine in the urine is a very good index of the total chlorine or sodium chloride intake and can be used for that purpose in practically all cases but kidney and very bad liver cases.

The retention or saliva level of chlorine is more important than the total chlorine in body chemistry. To maintain a normal chlorine level in the body is to secure freedom from gastric symptoms as well as a help to a normal blood pressure. A sufficiently high hydrochloric acid level is necessary for good calcium and phosphorus assimilation.

There are at least three important steps to a normal chlorine retention:

1. An adequate intake of sodium chloride which is about two level teaspoons per day for an adult; other high sodium foods are helpful.

2. Keep all fats and oils at a normal level. This can be measured by the phosphorus ratio which should not be less than 1 to 3 or higher than 1 to 4. In cases with inactive livers, enough whole bile or bile salts must be given to make possible a phosphorus ratio between the above limits. Where liver function is normal the amount of fats and oils controls chlorine retention to a marked degree. The lower the amount of fats in the diet the better the retention, while the higher the fat intake the poorer is chlorine retention and the greater the loss through the urine.

3. The amount of potassium in the diet must be within normal limits to maintain a normal chlorine level. A high intake

of potassium throws chlorine out through the urine, while a low intake makes for retention. The saliva value of the potassium should be about 1.0 milligrams per c.c. and the urine about 1.5 milligrams per c.c. or a total of 2.5 milligrams for saliva and urine. When the total potassium exceeds these figures chlorine retention is usually poor.

There are other reasons for maintaining a normal chlorine retention aside from its influence on the hydrochloric acid level, blood pressure and the assimilation of both calcium and phosphorus. I refer to its influence upon osmotic pressure, its influence upon water balance or water retention and a reported influence upon the suprarenal glands, especially the cortex.

Chlorine in common food is more abundant than sodium. Chlorine is not readily retained in the body without the aid of sodium; hence, the importance of a high sodium diet where chlorine is to be retained. The use of sodium bicarbonate or baking soda in hyperchlorhydria cases is contraindicated as it builds up hydrochloric acid or increases the dysfunction.

Many vegetarians on a low sodium chloride intake have been able to maintain a semblance of function by the liberal use of wheat germ or embryo which is extremely high in sodium and helps retain or build a normal sodium chloride level.

Summary

A normal chlorine level is maintained by the following factors:

1. Adequate sodium and sodium chloride intake.
2. The amount of fats and oils assimilated.
3. The amount of potassium foods in the diet.
4. The adequacy of liver function especially as it relates to fat assimilation.
5. The adequacy of kidney function especially as it relates to the elimination of sodium chloride.

VITAMIN A DETERMINATION

The use of the cholesterol test as a measure of Vitamin A has some very distinct advantages over the method which uses the estimation of night blindness by the photometer as an index. The most important factor is the getting away from the human element in arriving at a correct reading. It is necessary to get good cooperation from the patient when the photometer is used; this cannot always be done. The imagination or reaction time in some cases is such as to preclude accuracy. The use of special apparatus means increased expense as well as space. When we estimate Vitamin A by the cholesterol level we feel we have on an average a higher degree of accuracy as well as a decreased cost. These are two very important items.

In running a test for Vitamin A it is important to know the liver function. If there is a torpid or sluggish liver a low Vitamin A level is to be expected. We feel the phosphorus ratio is a simple accurate means of estimating the function of the liver as to fat assimilation. Carotene is water as well as fat soluble and is to be preferred as a routine method of securing this vitamin.

In checking the Vitamin A or cholesterol levels against the thyroid activity or basal rate our tests do not indicate at present any relationship. Our tests do, however, indicate a relationship between susceptibility to respiratory infections and colds, skin and mucous membrane tone, sinus infections, vision and the amount of sheen of the hair.

It may be of interest to know in developing a test for the Vitamin A requirements of the body we first noted that saliva cholesterol always ran parallel with blood cholesterol but not the same value. We then noted the relationship of Vitamin A and carotene to saliva cholesterol. There does not seem to be any reason why blood cholesterol cannot be used instead of saliva cholesterol. However, it is our belief that the drawing of blood in general creates more of an adverse mental attitude than that of securing a saliva sample.

We have called attention already to the antagonism between the pancreas and liver. It must be borne in mind that, in a sense, Vitamin A and Vitamin B are antagonists. When the level of Vitamin B is increased greatly, we speed up pancreatic function and this in turn depresses liver function. A torpid or sluggish liver cannot assimilate Vitamin A readily. It is therefore unwise to feed high Vitamin B when the liver is sluggish or the Vitamin A level is very low.

VITAMIN B DETERMINATION

The serum enzyme test of Oelgoetz has been modified and adapted to saliva and has been found to be a valuable method of establishing the ptyalin level of the saliva. It has been found that the amylitic value of the saliva runs parallel with the serum enzyme level of the blood. Oelgoetz has found his serum enzyme test to be an accurate index of the enzyme value of the external secretion of the pancreas. While the test is run on starch and is a direct measure of the amylitic power of the serum, it is claimed to be a valuable index of the protein and fat splitting capacity of the pancreas as well.

This starch digestion test as a measure of the ptyalin level of the saliva has also been found to run parallel with the Vitamin B level of the subject. When Vitamin B complex is increased in the diet, there is always a rise in the ptyalin level. Vitamin B Complex seems to be more effective in raising the ptyalin than Vitamin B_1. Wheat germ is highly efficient as well as dried Brewer's yeast. Thiamin chloride is efficient but much slower in raising ptyalin than the natural B Complex product of seemingly lower potency. When a Vitamin B concentrate is not available any good pancreatic product will give equivalent results.

A deficiency in Vitamin B tends to produce a very acid stool when the diet of the subject contains a generous amount of starch. When Vitamin B is added to such a diet the starch is rapidly converted to sugar and assimilated. This reduces the starch residue and prevents the formation of acid stools. If live yeast is fed as in yeast cakes, the zymase present tends to cause an acid stool. This is inclined to counteract the action of the Vitamin B present which alone would tend to cause stools to be alkaline.

When Vitamin B is a constant in the diet, a marked increase in the carbohydrate foods containing little or no Vitamin B will depress the ptyalin level. It is very evident that Vitamin B is necessary in the digestion of carbohydrates and must be in proportion to the intake.

When the percentage of refined carbohydrates is high in the diet Vitamin B will be low unless a concentrate of this Vitamin is being taken. When Vitamin B is low the ptyalin level in the saliva is low. If the ptyalin level is low in the face of a high starch residue in the mouth the extremes of acid fermentation can take place. The concentration of these acids is sufficient to cause dental decay and, therefore, a shortage of Vitamin B can be a serious factor in dental decay.

There is a balance between pancreatic function and liver function. When Vitamin B is increased with a corresponding increase in ptyalin a decrease in fat assimilation takes place as evidenced by a fall in the phosphorus ratio. The converse also is true for when ingested bile salts increase the phosphorus ratio, the ptyalin level falls proportionately.

The starch digestion test using raw starch seems to be a very accurate index of the level of Vitamin B in most cases and more sensitive than cooked starch. In rare cases the test employing cooked starch will detect a shortage not shown by the raw starch. Because of this occasional failure of the raw starch to show a slight shortage shown by the cooked product we find it advisable to run them in parallel. A failure of normal starch digestion either in raw or cooked starch is an index of a shortage and will be corrected by suitable doses of Vitamin B.

VITAMIN C DETERMINATION

The level of Vitamin C in the body is important not only from the standpoint of scurvy but on account of its influence on connective tissue and bone growth.

We have in Tillman's test a valuable method of establishing accurately the Vitamin C level. We want to know first whether the intake of this vitamin is adequate, and secondly whether the retention level is sufficient so the body and its tissues will be exposed to a suitable level at all times.

Unfortunately, there have been many exaggerated claims as to the amount of Vitamin C foods necessary for well-being. It has been found by us that 2.0 to 2.3 ounces of orange juice given as the sole or principal source of Vitamin C will secure a saliva level of 0.0020 to 0.0026 milligrams of cevitamic acid per c.c. and on an average give a urine level of 0.0075 milligrams per c.c. or 7.5 milligrams per 1000 c.c. of urine.

The minimum body requirement is generally accepted to be 150 International units of Vitamin C which is equivalent to 7.5 milligrams of cevitamic acid. If on feeding about 2 ounces of citrus juice or the amount of one fair sized orange we can demonstrate in the urine the minimum body's requirements eliminated as an excess, it would seem logical to assume that the full body's requirements are being met. Especially would this seem to be true when there is not the slightest evidence of a shortage as viewed from the clinical standpoint.

Because high Vitamin C foods are high potassium foods, considerable disturbance with poor retention as to calcium and chlorine occurs when unlimited quantities of citrus juice or tomato juice are consumed.

It is not generally known that a deficiency of Vitamin C can occur on a high fat and oil intake, as evidenced by a considerable loss of cevitamic acid through the urine and a fall in the saliva or retention level often below the limits of safety. A high intake of Vitamin C is no guarantee of safety if fats and oils are too high.

While citrus foods furnish us an attractive and palatable source of Vitamin C, yet where the cost is an item or skin rashes result from its use other high sources of this vitamin are available as in cabbage slaw, peas (either canned or fresh) and all melons.

Based upon hundreds of tests and several years experience with the Tillman technique for Vitamin C, we have no evidence to support the widespread feeling that a high percentage of the population is short in this vitamin. The evidence is quite conclusive that if a mixed diet is being consumed with a fair amount of raw and cooked vegetables there is little likelihood of a shortage. Our tests run in Southern California show only 1% of our patients short in Vitamin C in summer and 5% short in winter months.

VITAMIN D DETERMINATION

The phosphatase test which is being used in the diagnosis of rickets seems to be our best index of the Vitamin D level in the body at the present time. When properly performed we find the phosphatase test generally runs parallel with clinical symptoms and responds readily to Vitamin D administration. If our test shows Vitamin D low the administration of Cod Liver Oil, Viosterol or sunbaths will show, in nearly every case, an improvement in the phosphatase test.

In adapting the phosphatase test from blood serum to saliva there are a few suggestions and explanations that might be indicated. It has been found that increased accuracy will be secured if the saliva sample is held twelve to twenty-four hours in the ice box before the test is run. This period of holding will allow any food particles and mucus to settle out. The holding method seems to be superior to centrifuging. If care is used not to agitate the sample and the specimen is taken from the top, accurate results should be secured.

In reading the tests for the level of phosphatase we occasionally find the inorganic phosphorus sample to be higher than the total phosphorus sample which is the one containing substrate. This does not indicate a probable inaccuracy as the tubes are not comparable. When a negative test occurs the sample contains little or no phosphatase indicating a high Vitamin D intake. Negative or minus figures show a satisfactory Vitamin D level and are accurate for saliva work.

Because of the small amount of phosphatase in saliva it is advisable to take an average of three readings on the colorimeter. This increases materially the average accuracy.

PHYSICAL CHARACTERISTICS OF SALIVA AND URINE

SALIVA

We can learn some things about the saliva from a physical study of its characteristics.

The normal saliva is definitely turbid and quite milky with a somewhat opalescent appearance. Inasmuch as considerable calcium is either in a fine precipitate or in the colloidal state, the greater the turbidity on an average the greater the calcium content. Clear watery salivas are always low in calcium. Because of food residue it is not possible to measure the calcium accurately by means of turbidity or density.

On an average the mucin content of the saliva runs parallel with the consumption of sugar and pastry. There are a few individuals who seem to have saliva high in mucin who are definitely low in the consumption of sweets and pastry.

While every effort is made to keep mucus out of saliva, yet in spite of all precautions a definite amount often will be present. A low hydrochloric acid level of the stomach, and poor protein digestion with alkaline stools tend to run parallel with salivas containing high mucus. The amount of mucus can be more accurately gaged by letting the saliva stand for an hour or so.

URINE

An effort is made to rate urines as to color as light, medium or dark straw or amber. While the Specific Gravity generally tends to run parallel with color, the reliability of using color as an index of the specific gravity is not to be encouraged as too many cases fail to run parallel.

Urine turbidity that clears on the addition of acetic acid is due to phosphorus. A very alkaline urine may show marked turbidity even when the phosphorus is relatively low, while a very acid urine containing a high phosphorus content may be clear. The temperature also controls to some extent the amount of phosphorus held in solution. Heating a urine that is slightly turbid may produce complete clearing. The amount of phosphorus in the sample cannot be estimated by the turbidity unless we know the reaction of the liquid. Chemical analysis is the only way of knowing accurately the amount of phosphorus present.

Turbidity due to pus cells will not clear when acid is added to the urine sample and must not be confused with turbidity due to phosphorus.

Certain odors like that of ammonia are suggestive of metabolic disturbances of one kind or another. Some foods, as onions and asparagus, give pronounced characteristic odors.

The physical characteristics of both saliva and urine will help confirm some of the chemical findings at times.

SPECIFIC GRAVITY

At times the specific gravity can be of considerable help in a biochemical study. If the specific gravity of the urine is as low as 1.010 we know that one or more of the following conditions is present:

(a) The intake of minerals is low.
(b) There is faulty assimilation.
(c) Kidney elimination is poor.

While all the elements and waste products taken together control the specific gravity, yet the element phosphorus seems to run more nearly parallel with the specific gravity than any other factor studied. Because of this we have been able to establish a more nearly normal specific gravity than is generally used or accepted. Based on nearly five thousand diet cases controlled by chemical tests we have found that a phosphorus level of 0.588 to 0.600 milligrams per c.c. is about normal for the urine. The average specific gravity giving this range of phosphorus is 1.018. This value is considerably lower than is usually used as normal and seems to be a much safer or more reliable level to use. The text book values of 1.020 and 1.022 are definitely high and seem to be based on general averages rather than on an average of normal cases.

Insurance companies in general consider a specific gravity lower than 1.010 as indicative of kidney trouble or serious systemic disturbances and many cases have been rejected on account of the extremely low density of the urine. There is no question that there is a justification for feeling that extremely low specific gravities are indicative of a disturbed metabolism, but there is no justification for feeling that low gravity cases are caused essentially by kidney dysfunction.

The most common cause of low specific gravity is a torpid or sluggish liver. It is impossible to get rid of the waste products of the body in a normal way when the liver fails to function. The consistent use of whole bile or bile salts usually corrects this type of case.

The next most common type of case with low gravity urine is the hypothyroid that is controlling the weight by a very low food intake rather than with thyroid. Such cases are usually demineralized and low on vitamins unless concentrates of one type or another are being taken. It is definitely easier and probably more logical for a case with an extremely negative metabolic rate to use thyroid rather than hold the weight low by extreme restrictive measures as to food. Those electing the latter course are usually greatly demineralized and have dental difficulties.

Low specific gravities due to kidney trouble are extremely rare. In fact, many such cases have very high specific gravities. The facts justify us in thinking of low specific gravities in terms of poor liver and thyroid function rather than a possible kidney difficulty.

In diabetes we often find a high specific gravity when the phosphorus is low. This is due to the high amount of sugar in the urine. A high specific gravity in the face of a low mineral level of the urine calls for an explanation.

Acetone Test

A check for acetone is easily made and is of considerable value in diet regulation. When the fats and oils are too high for the amount of starch and sugar in the diet an acetone acidosis often results. It is a warning in a normal individual that the energy foods are not in proper relationship. A reduction in fats and an increase in starch is indicated. The acetone test can also be used to help locate diabetic individuals. Quite a percentage of diabetic individuals not on a restricted diet show acetone. When acetone is positive it is wise to run a sugar test on the urine and if negative follow with a blood sugar on all cases under suspicion for diabetes or where the phosphorus ratio is very low and acetone is present.

URATES

A positive test for urates is indicative of poor or faulty protein digestion. It tends to run parallel with a low hydrochloric acid level and a low blood or saliva chlorine level. When the saliva chlorine is restored to normal levels, which means a normal hydrochloric acid level, urates in the urine disappear rapidly provided the basal metabolic rate is about normal. In cases with a very negative basal metabolic rate urates will be seen in quantity when the chlorine is only slightly depressed. The level of chlorine, however, seems to be the more important of the two contributing factors mentioned.

A positive urate test is quite common in allergic cases, as a low hydrochloric acid level is common in that condition. It is a valuable confirmatory test for poor protein digestion and usually runs parallel with low hydrochloric acid. Urates and alkaline stools are quite common in hay fever cases and similar disturbances involving the mucous membrances.

SUGAR TESTS

The chief value of a sugar test is to locate diabetic patients. The acetone test seemed to lend itself better to that end than a test for sugar. The presence of sugar in the urine is not in itself diagnostic for diabetes, as a high intake of sugar may temporarily give positive tests. By using a test like Benedict's on all urines showing even a trace of acetone and a blood sugar test on questionable cases, probably most of the untreated cases of any marked severity will be located. The routine sugar test on all urines is perhaps a wise precaution.

ALBUMEN

The number of cases positive for albumen are very few in routine tests upon the urine. Because of the importance of locating each and every case that may have kidney dysfunction it is wise to be eternally vigilant for the slightest trace of albumen and to run an albumen on all urines.

ESTIMATING THE BASAL METABOLIC RATE

Because blood pressure and adequate calcium assimilation are often dependent upon the basal metabolic rate, the ability to establish a rough level is quite desirable and in some cases a necessity if we hope to normalize our patients.

When the pulse, temperature and blood pressure are accurately taken there is a definite relationship between them and the Basal Metabolic Rate. While this estimate is probably not so accurate as that made possible by our modern apparatus designed for that purpose, a fairly good estimate can usually be secured.

The fact that a slow pulse, low temperature and a low pulse pressure are often found in hypothyroid cases and the reverse in hyperthyroid cases has suggested computing formulas that can be found in some text books. However, in practice it is usually not necessary to compute out a formula to arrive at a rough estimate. The physical characteristics of the patient as to weight, mental alertness and general appearance will usually aid in the diagnosis.

In estimating the basal rate from pulse, temperature and blood pressure it is necessary for the patient to be quiet and alone for at least twenty minutes before these readings are made, otherwise they are of little value. We feel a pulse of 78 is very ideal. A temperature of 98.6° F. is normal, while a blood pressure of 100, plus the age less 10, is a good level during the prime of life.

When the pulse is below 72 it is a little too low, but whether the thyroid needs the support of glandular substances or iodine depends upon the patient.

A subnormal temperature as 98.4° F. or lower is more readily corrected by sea kelp than thyroid. The high Vitamin E content of sea kelp seems to be the the active agent which raises the temperature although the iodine content may be of some value.

The low blood pressure found in most cases of hypothyroidism may be due in part to other factors than the inactive thyroid. These contributing factors may be poor chlorine retention, low Vitamin B etc.

CHAPTER VIII

DIET SHEET AND CLASSIFIED FOOD LISTS

The following is an average diet program based on the amount and type of food found necessary to secure normal chemical levels in individuals free from serious pathology. An average diet schedule can be successful only when assimilation and elimination are average. It is just as logical to make one size of clothes for the general public as to expect to maintain normal chemistry and health in the population as a whole by a hard and fixed food or health program no matter how scientific that program may be.

The diet sheet shown here is an average sheet in every sense of the word and will not meet the requirements necessary to maintain a normal chemistry where metabolism is very far removed from average. The food schedule shown has proved to be a very valuable one however and makes a good starting point in diet regulation.

It takes about six weeks to normalize the chemistry of an individual. If after that period the suggested quantities of food fail to bring about a correction, definite changes must be made either as to quantity or as to the assimilation.

The classified food lists can be of considerable help at times to educate the patient quickly to the types of foods that will have to be increased or decreased to secure a correction of the chemistry.

This diet sheet has been evolved over a period of ten years with the aid of our chemistry. It has been tested clinically on several thousand cases, and has proved to be a valuable framework which can be adjusted easily for each individual case.

PROTEIN

Meat—6 times per week—beef, lamb or poultry (which includes one meal of liver, kidney, baked heart or chicken giblets).

Fish—1 time per week—(salt water fish, canned or fresh, clams, oysters).

Eggs—7 eggs per week—(either as a plain egg or in the cooking).

Cheese—American or any rennin curded cheese. Two pieces the size of a walnut per day or a more generous helping of cottage cheese.

CARBOHYDRATES—Cereal Foods.

1 medium helping of breakfast cereal. The whole grain cereals are greatly to be preferred.

3 slices of whole grain bread per day—(wheat, corn or rye).

Potatoes—White or sweet at least once per day and usually all you wish—(baked, scalloped, mashed or creamed. Avoid all forms of fried potatoes).

Legumes—Peas about three times per week. Baked or lima beans not over once per week.

Sweets—Sugar and candy—hold very low. Use dried fruits—figs, raisins and dates—in moderation.

FATS

Real butter very much to be desired. If substitutes are used a supplement containing Vitamin A and possibly Vitamin D is indicated.

Amount of fats and oils depends upon the digestion and weight. As a rule the amount should be low.

VEGETABLES

1 raw salad per day—(lettuce, slaw, celery, tomatoes, carrots, avocados, etc.).

1 or 2 non-starch cooked vegetables per day—(spinach, carrots, swiss chard, asparagus, string beans, squash, turnips, beets, parsnips, artichokes, cauliflower, onions, etc.)

DESSERT

Favor the raw fruits as oranges, grapefruit, pineapple, pears, apples, bananas, figs, melons and small fruits (grapes, berries, sweet cherries, peaches, apricots).

Vary with custards, tapioca, sago, cornstarch and pumpkin puddings.

Ices or ice cream—not over twice per week.

Nuts—(almonds, walnuts, pecans, brazil nuts)—in moderation only.

Gelatine—not more than once per week.

LIQUID

Most soups desirable.

Whole milk, skim milk or buttermilk—not more than a quart or less than a pint per day.

The use of fruit or vegetable juices usually not desirable—(orange, grapefruit, pineapple, grape, tomato and sweet cider).

Not less than eight glasses of liquid per day.

SALT

As a rule keep table salt high.

FOODS TO BE KEPT VERY LOW OR OUT OF DIET

Cake, pie, pastry, cereal puddings—(bread and rice).

Crackers, macaroni, noodles and rice.

Peanuts, prunes, plums, cranberries, rhubarb and sour cherries.

Coffee, tea, chocolate, cocoa and all cereal coffees as well as malted milk and similar products.

Soft drinks as soda pop and cola drinks.

Condiments as mustard, pepper, chili, cocktail and meat sauces.

DAILY CALORIC REQUIREMENTS

Age 1 to 5 years		1000—1600 calories
Age 6 to 10 years		1400—2400 calories
Age 10 to 13 years	Boys:	2100—3200 calories
	Girls:	1800—2800 calories
Age 14 to 17 years	Boys:	2600—4000 calories
	Girls:	2200—2800 calories
Adults—Light Work	Men:	2200—2800 calories
	Women:	1800—2200 calories
Adults—Heavy Work	Men:	3000—3500 calories
	Women:	2500—3000 calories

ACID FOODS

All grain foods
All meat, fish and eggs
Coffee, tea, chocolate
Cocoa, cereal coffee
Most soft drinks
Gelatine
All foods containing high benzoic and oxalic acid.

ANIMAL PROTEIN

- Beef
- Lamb
- Poultry
- Veal
- Pork
- Liver
- Heart
- Kidney
- Sweetbreads
- Brains
- Eggs
- Milk
- Cheese
- Seafood
  - Fish
  - Clams
  - Oysters
  - Lobsters
  - Crabs
  - Shrimp

ACID STARCH

- Cereals (wheat, corn, oats, rice)
- Bread (wheat, corn, rye)
- Crackers
- Macaroni
- Noodles
- Rice
- Cake and Pastry

PASTRY AND PUDDINGS

- Cake
- Pie
- Pastry
- Bread Pudding
- Rice Pudding
- Custard
- Tapioca
- Sago
- Cornstarch
- Pumpkin

BENZOIC AND OXALIC FOODS

- Prunes and plums
- Cranberries
- Rhubarb
- Sour cherries

ACID DRINKS

- Coffee
- Tea
- Chocolate
- Cocoa
- Cereal coffee
- Most soft drinks

ALKALINE FOODS

- All fruits and vegetables
- All true nuts
- Milk and Buttermilk

ALKALINE STARCH

- Potatoes (white, sweet)
- Bananas
- Peas
- Beans (baked, lima, soya)

VEGETABLE SALADS

- Lettuce
- Slaw
- Celery
- Tomatoes
- Carrots
- Avocado

COOKED VEGETABLES

- Spinach
- Carrots
- Swiss chard
- Asparagus
- String beans
- Squash
- Beets
- Artichokes
- Turnips
- Parsnips
- Cauliflower
- Onions

FRUIT JUICE

- Orange
- Grapefruit
- Lemon
- Pineapple
- Tomato
- Grape
- Cider

ALKALINE DRINKS

- Whole milk
- Skim milk
- Buttermilk
- Fruit juice
- Vegetable juice

NEUTRAL FOODS

- Sugar
- Pure starch
- Fats and oils
- Tapioca
- Sago

SWEETS

- Candy
- Sugar
- Chocolate
- Honey
- Figs (dried)
- Raisins
- Dates

VITAMIN FOODS

VITAMIN A

- Apricots
- Peaches
- Carrots
- Potatoes (sweet)
- Butter
- Cheese (whole milk)
- Cream
- Milk (whole)
- Liver
- Eggs
- Cod Liver Oils
- Carotene
- Peas
- Spinach
- Watercress

VITAMIN B1

- Asparagus
- Avocado
- Bread (Graham)
- Bread (whole wheat)
- Shredded wheat
- All unrefined cereals
- Wheat germ
- Yeast

VITAMIN B2 (G)

- Avocado
- Asparagus
- Spinach
- Beet leaves
- Eggs
- Kidney
- Liver
- Milk (whole)
- Milk (skim)
- Buttermilk
- Cream

VITAMIN C

- Oranges
- Lemon
- Grapefruit
- Strawberries
- Cantaloupe
- Watermelon
- Peaches
- Tomatoes
- Cabbage (raw)
- Peas (canned, fresh)
- Spinach
- Watercress
- Sprouted seeds
- Onions (raw)

VITAMIN D

- Eggs
- Milk (irradiated or metabolized)
- Cod liver oil
- Sunbaths
- Fish

VITAMIN E

- Leafy vegetables
- Liver
- Egg yolk
- Seeds
- Wheat germ oil
- Wheat germ
- Kelp

HIGH FAT AND OIL FOOD

- Whole milk
- Butter
- Cream
- Ice Cream
- All cheese but cottage
- Bacon
- Gravies
- Sausage
- Pork products
- Mutton
- Lamb chops
- Fatty beef cuts
- All nuts
- Doughnuts
- Chocolate
- Cocoa
- Olives
- Avocado
- Salad dressings
- Potato chips

CITRIC ACID FRUITS

- Oranges
- Grapefruit
- Lemon
- Lime
- Pineapple
- All berries
- Loquats
- Pomegranate
- Dates
- Tomato
- Cranberries
- Guava
- Mango

MALIC ACID FRUITS

- Apple
- Apricot
- Cherry
- Grapes
- Raisins
- Peaches
- Quince
- Rhubarb
- Tomato
- Plums
- Prunes
- Persimmons

BENZOIC AND OXALIC ACID FOODS

- Prunes
- Plums
- Cranberries
- Rhubarb
- Sour cherries

CALCIUM FOODS

- Whole milk
- Skim milk
- Buttermilk
- American cheese
- Swiss cheese
- Cottage cheese
- Malted milk

POTASSIUM FOODS

- Bananas
- Beans (dried and lima)
- Caviar
- Chocolate and cocoa
- Dandelions
- Honey
- Fruit and vegetable juice
- Dried fruits
- Condiments (mustard, etc.)
- Nuts
- Meat extracts
- Molasses
- Olives
- Parsnips
- Potassium salt
- Potatoes
- Spinach
- Wheat bran
- Soft drinks

SODIUM FOODS

- Table salt
- Soda crackers
- Clams
- Oysters
- Wheat germ
- Rye bread
- Gluten products
- Bread
- Blood (rare beef juice)

MAGNESIUM FOODS

- Nuts
- Cereals
- Bread
- Beans (dried)
- Chocolate and cocoa
- Condiments
- Peas
- Legumes
- Wheat germ

SULPHUR FOODS

- Nuts
- Meat
- Fish
- Cereals
- Bread
- Cake and pastry
- Beans
- Peas
- Legumes
- Cabbage
- Brussel Sprouts
- Chard
- Cheese
- Chocolate and cocoa
- Eggs
- Condiments
- Molasses
- Wheat germ
- Wheat gluten

PHOSPHORUS FOODS

- Meat
- Fish
- Eggs
- Cereals
- Bread
- Peas
- Beans
- Nuts
- Soft drinks

IRON FOODS

- Liver
- Heart
- Meat
- Oysters
- Sweetbreads
- Spinach
- Eggs
- Bread (graham)
- Bread (whole grain)
- Oats

IODINE FOODS

- Fish (salt water)
- Clams
- Oysters
- Kelp
- Iodized salt

SOURCES OF BULK

- Bran
- Dried figs
- Celery
- Swiss chard
- Spinach
- Turnips
- Watercress
- Slaw

HIGH CALORIC FOODS

- Fats and Oils
- Butter
- Cheese (all but cottage)
- Cream
- Bacon
- Cereals
- Bread
- Cake and pastry
- Sugar
- Candy
- Nuts

LOW CALORIC FOODS

- Lettuce
- Celery
- Cucumbers
- Asparagus
- Endive
- Swiss chard
- Watercress
- Okra
- Cauliflower
- Egg plant
- Radishes
- String beans
- Broccoli
- Artichokes

CHAPTER

IX

ACTUAL TESTS FOR DETERMINATIONS OF CHEMICAL LEVELS

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COLORIMETRIC METHOD OF MEASURING pH AND BUFFER VALUES (Using La Motte 3B Testing Set)

SALIVA AND URINE

1. Set up the small glass cells from pH 5.2 to pH 7.8.

2. To each cell add five drops of La Motte Buffer Mixture. Keep dropper straight up and down for even-sized drops.

3. Add 1 drop of Chlorphenol Red Indicator to cells 5.2 to 6.4 inclusive.

4. Add 1 drop of Phenol Red Indicator to cells 6.6 to 8.4.

5. Agitate to mix.

6. Deliver 1 drop of urine to each of two empty cells after mixing of sample.

7. Deliver 1 drop of saliva to each of two empty cells, after mixing the saliva sample well. Select the sample from near the surface to avoid excessive mucus. Sediment makes the reading difficult in saliva.

8. Add 3 drops of triple distilled water to each of the four cells.

9. To 1 saliva cell add 1 drop of Phenol Red. The reading usually comes in this range. Agitate to mix and read at once. This is the actual pH value. Set aside to read again in one hour for the buffer value.

10. Leave the other saliva cell without indicator for 1 hour which allows CO_2 equalization to take place. At the end of this time add indicator and read immediately. This gives the pH value after CO_2 elimination.

11. To 1 urine cell add 1 drop of Chlorphenol Red. Agitate to mix. Reading usually comes in this range. If it is above 6.4 add Phenol Red to the other cell, or if it below 5.0 use Methyl Red. Read the cell again in exactly 1 hour for buffer value.

12. In one hour read both the urine and saliva cells. Record as follows:

Saliva: Actual pH value—pH value after CO_2 equalization—pH reading indicating buffer value.

Urine: Actual pH value—pH reading indicating buffer value.

FECES

1. Cover the specimen with distilled water without agitation and let it stand for 2 to 3 hours in the ice box. The proportion should be about 1 of stool to 4 of water.

2. Put 1 drop of clear liquid in a small cell. Be careful to avoid sediment.

3. Add three drops of triple distilled water.

4. Add 1 drop of Phenol Red. Read immediately. The reading usually comes in this range. If the stool is below 6.6, prepare another cell and use Chlorphenol Red as an indicator. The true pH reading is used in this case.

5. Rinse pipette and cell in cleaning solution. Rinse thoroughly with distilled water.

Reagents:

LaMotte Buffer Mixtures 4.8 - 8.4.
Chlorphenol Red Indicator (alcoholic).
Phenol Red Indicator (alcoholic).
Triple distilled water.

Normals:	Adults	Children
Saliva	7:6 Buffer	7.8 Buffer
Urine	6.2 Buffer	6.0 Buffer
Stool	6.8 - 7.0 pH	6.8 - 7.0 pH

CALCIUM DETERMINATION
(Modified Kramer and Tisdall)

SALIVA AND URINE

1. Deliver 1 c.c. of specimen to centrifuge tube.

2. Add ½ c.c. of 3% Ammonium Oxalate. This precipitates the calcium into insoluble calcium oxalate.

3. Agitate and see that the specimen and oxalate are thoroughly mixed.

4. Allow to stand 12 hours or over night at room temperature.

5. Add 4 c.c. distilled water to centrifuge tube.

6. Centrifuge 5-10 minutes at 1800 rev./min.

7. Decant water without agitation.

8. Break up precipitate.

9. Add distilled water to 5 c.c. mark and centrifuge again for 5 minutes.

10. Decant water without agitation.

11. Break up precipitate.

12. Add 3 c.c. of hot 1N H_2SO_4 and centrifuge 5 minutes. The sulphuric acid puts the calcium into solution.

13. Decant liquid into a marked evaporating dish.

14. Break up precipitate.

15. Add 3 c.c. more of hot sulphuric acid and centrifuge 5 minutes at 1800 rev./min.

16. Pour liquid into the same evaporating dish. Discard precipitate.

17. Heat liquid in evaporating dish until vapor rises (90° C.).

18. Titrate while hot with 0.01N $KMnO_4$ until it holds a pale pink color for 1 minute.

19. Multiply burette reading by 0.2 and this is the milligrams of calcium per c.c. of specimen.

During titration the saliva has a tendency to fade after the first end point is reached and several drops may have to be added to make it hold a color the full minute. The urine usually holds its first end point.

Reagents:

Stock Solution of potassium permanganate—0.1N $KMnO_4$. Use 3.162 gms. $KMnO_4$ to 1000 c.c. volumetric flask. Dilute with water to mark.

1. Titrating Solution: 105 c.c. of stock $KMnO_4$ and make to 1000 c.c.
2. Ammonium Oxalate (DeHaën's) 3%.
3. 1N H_2SO_4 - 24.519 gms. Conc. H_2SO_4 to 500 c.c. H_2O.

Normals:	Adults	Children
Saliva	.37 mg/cc.	.24 mg/cc.
Urine	.10 mg/cc.	.12 mg/cc.

PHOSPHORUS DETERMINATION
(Bell-Doisy-Briggs Technique)

1. Deliver 1 c.c. of specimen to a test tube marked for 10 c.c.

2. Add 1 c.c. Trichloracetic acid—20%.

3. Agitate and allow to stand for 10 minutes.

4. Add distilled water to the 10 c.c. mark.

5. Filter. Use Whatman No. 5 filter paper for the saliva and Whatman No. 1 filter paper for the urine.

6. Deliver 5 c.c. of the filtrate back into the original tube which has been rinsed thoroughly with distilled water. Rinse the pipette with a little of the specimen before delivering it into the tube.

7. Set up the Standard Tubes.
   a. To one clean test tube add 3 c.c. of KH_2PO_4—Strength is 0.025 mg. of P per c.c.
   b. To one clean test tube add 3 c.c. of KH_2PO_4—Strength is 0.010 mg. of P. per c.c.

8. To both the standard tubes and the specimen tubes add the following:

   1 c.c. Molybdate Solution (gives yellow color).
   1 c.c. Hydroquinone Solution (gives green color).
   1 c.c. Sodium Sulphite Solution (gives true blue color).

9. Add distilled water to the 10 c.c. mark.

10. Mix thoroughly with plunger stirring rod.

11. Allow to stand ½ to 2 hours to develop color.

12. Read in a colorimeter with standard set at 30.

13. The amount of phosphorus is determined from the table. Result is expressed in milligrams per c.c. of sample.

Reagents:

Trichloracetic Acid (Merke) 20%.
Molybdate Solution:

Solution A—12.5 gms. Ammonium Molybdate.
150 c.c. H_2O (distilled).
Solution B—62.5 c.c. distilled H_2O.
37.5 gms. Conc. H_2SO_4.
Add solution B to solution A.

Hydroquinone Solution:
0.5 gms. Hydroquinone.
100 c.c. H_2O (distilled).
1 drop Conc. H_2SO_4.

Sodium Sulphite Solution: (20% Sodium Sulphite)
20 gms. $NaSO_3$ (anhydrous) to
180 c.c. distilled H_2O.

Stock Solution:
0.4394 gms. KH_2PO_4 per 1000 c.c. distilled H_2O.
1 c.c. is equivalent to 0.1 mg. Phosphorus.

Standard Solutions:
.025 KH_2PO_4 - 50 c.c. stock to 150 c.c. H_2O.
1 c.c. is equivalent to 0.025 mg. Phosphorus.
0.010 KH_2PO_4 - 25 c.c. stock to 225 c.c. H_2O.
1 c.c. is equivalent to 0.010 mg. Phosphorus.

Normals:	Adults	Ratio	Children	Ratio
Saliva	.186 mgs./c.c.	1	.150 mgs./c.c.	1
Urine	.558 mgs./c.c.	3	.600 mgs./c.c.	4
Total	.744 mgs.		.750 mgs.	

Phosphorus Standard .025

2.0	2.250	6.0	.750	10.0	.450
2.1	2.143	6.1	.737	10.1	.446
2.2	2.045	6.2	.726	10.2	.441
2.3	1.957	6.3	.714	10.3	.437
2.4	1.875	6.4	.703	10.4	.432
2.5	1.800	6.5	.692	10.5	.428
2.6	1.733	6.6	.686	10.6	.424
2.7	1.674	6.7	.672	10.7	.420
2.8	1.607	6.8	.662	10.8	.417
2.9	1.552	6.9	.652	10.9	.413
3.0	1.500	7.0	.643	11.0	.409
3.1	1.451	7.1	.634	11.1	.405
3.2	1.406	7.2	.625	11.2	.402
3.3	1.364	7.3	.616	11.3	.398
3.4	1.324	7.4	.608	11.4	.395
3.5	1.286	7.5	.600	11.5	.391
3.6	1.250	7.6	.592	11.6	.388
3.7	1.216	7.7	.584	11.7	.385
3.8	1.184	7.8	.577	11.8	.381
3.9	1.154	7.9	.569	11.9	.378
4.0	1.125	8.0	.562	12.0	.375
4.1	1.098	8.1	.556	12.1	.372
4.2	1.071	8.2	.549	12.2	.369
4.3	1.047	8.3	.542	12.3	.366
4.4	1.023	8.4	.536	12.4	.363
4.5	1.000	8.5	.529	12.5	.360
4.6	.978	8.6	.523	12.6	.357
4.7	.957	8.7	.517	12.7	.354
4.8	.937	8.8	.511	12.8	.352
4.9	.918	8.9	.506	12.9	.349
5.0	.900	9.0	.500	13.0	.346
5.1	.882	9.1	.495	13.1	.344
5.2	.865	9.2	.489	13.2	.341
5.3	.849	9.3	.484	13.3	.338
5.4	.833	9.4	.479	13.4	.336
5.5	.818	9.5	.474	13.5	.333
5.6	.804	9.6	.469	13.6	.331
5.7	.789	9.7	.464	13.7	.328
5.8	.776	9.8	.459	13.8	.326
5.9	.763	9.9	.455	13.9	.324

Phosphorus Standard .025 (Cont.)

14.0	.321	18.0	.250	22.0	.205
14.1	.319	18.1	.249	22.1	.204
14.2	.317	18.2	.247	22.2	.203
14.3	.315	18.3	.246	22.3	.202
14.4	.313	18.4	.245	22.4	.201
14.5	.310	18.5	.243	22.5	.200
14.6	.308	18.6	.242	22.6	.199
14.7	.306	18.7	.241	22.7	.198
14.8	.304	18.8	.239	22.8	.197
14.9	.302	18.9	.238	22.9	.197
15.0	.300	19.0	.237	23.0	.196
15.1	.298	19.1	.236	23.1	.195
15.2	.296	19.2	.234	23.2	.194
15.3	.294	19.3	.233	23.3	.193
15.4	.292	19.4	.232	23.4	.192
15.5	.290	19.5	.231	23.5	.191
15.6	.288	19.6	.230	23.6	.191
15.7	.287	19.7	.228	23.7	.190
15.8	.285	19.8	.227	23.8	.189
15.9	.283	19.9	.226	23.9	.188
16.0	.281	20.0	.225	24.0	.187
16.1	.279	20.1	.224	24.1	.187
16.2	.278	20.2	.223	24.2	.186
16.3	.276	20.3	.222	24.3	.185
16.4	.274	20.4	.221	24.4	.184
16.5	.273	20.5	.220	24.5	.184
16.6	.271	20.6	.218	24.6	.183
16.7	.269	20.7	.217	24.7	.182
16.8	.268	20.8	.216	24.8	.181
16.9	.266	20.9	.215	24.9	.181
17.0	.265	21.0	.214	25.0	.180
17.1	.263	21.1	.213	25.1	.179
17.2	.262	21.2	.212	25.2	.178
17.3	.260	21.3	.211	25.3	.177
17.4	.259	21.4	.210	25.4	.177
17.5	.257	21.5	.209	25.5	.176
17.6	.256	21.6	.208	25.6	.176
17.7	.254	21.7	.207	25.7	.175
17.8	.253	21.8	.206	25.8	.174
17.9	.251	21.9	.205	25.9	.173

Phosphorus Standard .025 (Cont.)

26.0	.173	30.0	.150
26.1	.172	30.1	.150
26.2	.172	30.2	.149
26.3	.171	30.3	.149
26.4	.171	30.4	.148
26.5	.170	30.5	.148
26.6	.169	30.6	.147
26.7	.169	30.7	.147
26.8	.168	30.8	.146
26.9	.167	30.9	.146
27.0	.167	31.0	.145
27.1	.166	31.1	.145
27.2	.166	31.2	.144
27.3	.165	31.3	.144
27.4	.165	31.4	.143
27.5	.164	31.5	.143
27.6	.163	31.6	.142
27.7	.162	31.7	.142
27.8	.162	31.8	.142
27.9	.161	31.9	.141
28.0	.161	32.0	.141
28.1	.160	32.1	.140
28.2	.160	32.2	.140
28.3	.159	32.3	.139
28.4	.159	32.4	.139
28.5	.158	32.5	.138
28.6	.157	32.6	.138
28.7	.157		
28.8	.156		
28.9	.156		
29.0	.155		
29.1	.155		
29.2	.154		
29.3	.154		
29.4	.153		
29.5	.153		
29.6	.152		
29.7	.152		
29.8	.151		
29.9	.151		

mgs. P per c.c. = 4.5 ÷ Colorimetric Reading

Phosphorus Standard .010

7.0	.257	11.0	.164	15.0	.120
7.1	.254	11.1	.162	15.1	.119
7.2	.250	11.2	.161	15.2	.118
7.3	.247	11.3	.159	15.3	.118
7.4	.243	11.4	.158	15.4	.117
7.5	.240	11.5	.157	15.5	.116
7.6	.237	11.6	.155	15.6	.115
7.7	.234	11.7	.154	15.7	.115
7.8	.231	11.8	.153	15.8	.114
7.9	.228	11.9	.151	15.9	.113
8.0	.225	12.0	.150	16.0	.113
8.1	.222	12.1	.149	16.1	.112
8.2	.220	12.2	.148	16.2	.111
8.3	.217	12.3	.146	16.3	.110
8.4	.214	12.4	.145	16.4	.110
8.5	.212	12.5	.144	16.5	.109
8.6	.209	12.6	.143	16.6	.108
8.7	.207	12.7	.142	16.7	.108
8.8	.205	12.8	.141	16.8	.107
8.9	.202	12.9	.140	16.9	.107
9.0	.200	13.0	.138	17.0	.106
9.1	.198	13.1	.137	17.1	.105
9.2	.196	13.2	.136	17.2	.105
9.3	.194	13.3	.135	17.3	.104
9.4	.191	13.4	.134	17.4	.103
9.5	.189	13.5	.133	17.5	.103
9.6	.188	13.6	.132	17.6	.102
9.7	.186	13.7	.131	17.7	.102
9.8	.184	13.8	.130	17.8	.101
9.9	.182	13.9	.129	17.9	.101
10.0	.180	14.0	.129	18.0	.100
10.1	.178	14.1	.128	18.1	.099
10.2	.176	14.2	.127	18.2	.099
10.3	.175	14.3	.126	18.3	.098
10.4	.173	14.4	.125	18.4	.098
10.5	.171	14.5	.124	18.5	.097
10.6	.170	14.6	.123	18.6	.097
10.7	.168	14.7	.122	18.7	.096
10.8	.167	14.8	.122	18.8	.096
10.9	.165	14.9	.121	18.9	.095

Phosphorus Standard .010 (Cont.)

19.0	.095	23.0	.079	27.0	.067
19.1	.094	23.1	.078	27.1	.067
19.2	.094	23.2	.078	27.2	.066
19.3	.093	23.3	.077	27.3	.066
19.4	.093	23.4	.077	27.4	.066
19.5	.092	23.5	.077	27.5	.065
19.6	.092	23.6	.076	27.6	.065
19.7	.091	23.7	.076	27.7	.065
19.8	.091	23.8	.076	27.8	.065
19.9	.090	23.9	.075	27.9	.064
20.0	.090	24.0	.075	28.0	.064
20.1	.090	24.1	.075	28.1	.064
20.2	.089	24.2	.074	28.2	.064
20.3	.089	24.3	.074	28.3	.064
20.4	.088	24.4	.074	28.4	.063
20.5	.088	24.5	.073	28.5	.063
20.6	.087	24.6	.073	28.6	.063
20.7	.087	24.7	.073	28.7	.063
20.8	.087	24.8	.073	28.8	.063
20.9	.086	24.9	.072	28.9	.062
21.0	.086	25.0	.072	29.0	.062
21.1	.085	25.1	.072	29.1	.062
21.2	.085	25.2	.071	29.2	.062
21.3	.085	25.3	.071	29.3	.061
21.4	.084	25.4	.071	29.4	.061
21.5	.084	25.5	.071	29.5	.061
21.6	.083	25.6	.070	29.6	.061
21.7	.083	25.7	.070	29.7	.061
21.8	.083	25.8	.070	29.8	.060
21.9	.082	25.9	.069	29.9	.060
22.0	.082	26.0	.069	30.0	.060
22.1	.081	26.1	.069	30.1	.060
22.2	.081	26.2	.069	30.2	.060
22.3	.081	26.3	.068	30.3	.059
22.4	.080	26.4	.068	30.4	.059
22.5	.080	26.5	.068	30.5	.059
22.6	.080	26.6	.068	30.6	.059
22.7	.080	26.7	.067	30.7	.059
22.8	.079	26.8	.067	30.8	.058
22.9	.079	26.9	.067	30.9	.058

mgs. P per c.c. = 1.8 ÷ Colorimetric Reading

CHLORINE DETERMINATION
(Folin's Method)

1. Deliver 1 c.c. specimen to a small beaker.
2. Add 4 c.c. distilled water to each specimen.
3. Add 1 c.c. Ferric Ammonium Sulphate Indicator.
4. Add 2 c.c. $AgNO_3$ Solution with a pipette as accurately as possible.
5. Titrate with NH_4CNS Solution until a pale orange end point appears. Titrate slowly and agitate mixture continually. End point is sharp.
6. For calculation subtract the difference between the burette readings from 10. This gives the milligrams of chlorine per 1 c.c. of sample.

The solutions are always standardized when they are first made up. The $AgNO_3$ is titrated against the NH_4CNS so the 2 c.c. of silver nitrate equal 10 c.c. ammonium thiocyanate.

Reagents:

1. Ferric ammonium sulphate indicator.
   100 gms. $FeNH_4(SO_4)_2$ to
   100 c.c. distilled H_2O and
   200 c.c. Conc. HNO_3.
2. Silver nitrate solution.
   12.13 gms. $AgNO_3$ to
   500 c.c. H_2O in volumetric flask.
3. Titrating solution.
   2.105 gms. NH_4CNS to
   1000 c.c. H_2O in volumetric flask.

Normals:	Adults	Children
Saliva	.90 mgs./c.c.	.72 mgs./c.c.
Urine	2.70 mgs./c.c.	2.88 mgs./c.c.

In the saliva a range of .72 to .90 is satisfactory.

A purple color appearing between steps 4 and 5 indicates the presence of aspirin.

POTASSIUM DETERMINATION
(Modified Kramer and Tisdall)

1. Deliver 0.5 c.c. urine or saliva to a centrifuge tube.

2. To urine add 2 c.c. sodium cobalt nitrite solution and to the saliva 1 c.c. of sodium cobalt nitrite solution which has been filtered before using. Add it slowly and by drops, with agitation of the tube.

3. Let stand over night in the ice box.

4. Add 2 c.c. distilled water to the tubes.

5. Centrifuge at 1300 - 1400 revolutions for ½ hour.

6. Pipette off supernatant liquid. Do not disturb the precipitate.

7. Run 5 c.c. water down the side of the tube and agitate gently.

8. Centrifuge 5 minutes.

9. Repeat the washing and centrifuging three times more so that there are four washings in all. The supernatant liquid from the last washing should be perfectly clear.

10. Add 3 c.c. potassium permanganate (0.1N) from a burette.

11. Add 1 c.c. 4N sulphuric acid. Mix with a glass rod.

12. Heat in a boiling water bath for 1½ minutes. If all the color disappears add 1 c.c. more of the potassium permanganate. Continue until it will hold the color for ½ minute in the boiling water bath.

13. Add from a burette—slowly, a few drops at a time—enough 0.1N sodium oxalate to decolorize the solution completely. Reheat between additions of oxalate if necessary. The excess of oxalate is then titrated back with 0.1N $KMnO_4$ to a faint pink color.

14. Run a blank as follows:

    Add 3 c.c. of $KMnO_4$ to a clean tube.

Add 1 c.c. 4N H_2SO_4.

Heat in a boiling water bath 1 minute.

Add 0.1N sodium oxalate to decolorize.

Titrate back with $KMnO_4$ to a faint pink.

15. Calculations:

Blank Correction: Subtract the c.c. of sodium oxalate used from the c.c. of potassium permanganate solution used in the blank. This gives the blank correction.

Potassium Calculation: Subtract the blank correction from the total c.c. of permanganate used.

Subtract the total c.c. of sodium oxalate used from the above figure.

Multiply by 0.71.

Multiply by 2.0.

The answer gives the milligrams of potassium in 1 c.c. of sample.

Example of Calculations:

Blank	$Na_2C_2O_4$	$KMnO_4$	
	15.68	11.30	3.07
	12.65	8.23	3.03
	3.03	3.07	.04

Blank correction is 0.04.

Saliva	17.38	14.40
	15.68	11.30
	1.70	3.10

3.10 - .04 - 1.70 x .71 x 2=1.9312 mg. of K/c.c.

Urine	19.68	17.55
	17.38	14.40
	2.30	3.15

3.15 - .04 - 2.30 x .71 x 2=1.1502 mg. K/c.c.

Ratio is 1 to 0.59.

Reagents:

1. 0.1N $KMnO_4$ - 3.162 gms. per 1000 c.c. H_2O.

2. 0.1N $Na_2C_2O_4$ - 6.7 gms. salt for 1000 c.c. H_2O plus 5.0 c.c. Conc. H_2SO_4.
3. 4N H_2SO_4 - 20 c.c. Conc. H_2SO_4 (19.608 gms.) in 100 c.c. H_2O.
4. Sodium Cobalt Nitrite Solution.

Solution A—25 gms. Cobaltous Nitrate Crystals.
50 c.c. distilled H_2O.
12.5 c.c. Glacial Acetic Acid.

Solution B—120 gms. Sodium Nitrite (K free).
180 c.c. distilled H_2O.
Gives a volume of 220 c.c.

To all of solution A add 210 c.c. of solution B. An evolution of Nitric Oxide gas occurs. Air is forced gently through the solution until all gas has passed off. Place in ice box. Filter before using.

Normals:	Adults	Ratio	Children	Ratio
Saliva	1.000 mgs./c.c.	1	0.833 mgs./c.c.	1
Urine	1.500 mgs./c.c.	1.5	1.667 mgs./c.c.	2.0
Total	2.500 mgs.		2.500 mgs.	

Potassium Standards

.50	.7100	.90	1.2780	1.30	1.8460
.51	.7242	.91	1.2922	1.31	1.8602
.52	.7384	.92	1.3064	1.32	1.8744
.53	.7526	.93	1.3206	1.33	1.8886
.54	.7668	.94	1.3348	1.34	1.9028
.55	.7810	.95	1.3490	1.35	1.9170
.56	.7952	.96	1.3632	1.36	1.9312
.57	.8094	.97	1.3774	1.37	1.9454
.58	.8236	.98	1.3916	1.38	1.9596
.59	.8378	.99	1.4058	1.39	1.9738
.60	.8520	1.00	1.4200	1.40	1.9880
.61	.8662	1.01	1.4342	1.41	2.0022
.62	.8804	1.02	1.4484	1.42	2.0164
.63	.8946	1.03	1.4626	1.43	2.0306
.64	.9088	1.04	1.4768	1.44	2.0448
.65	.9230	1.05	1.4910	1.45	2.0590
.66	.9372	1.06	1.5052	1.46	2.0732
.67	.9514	1.07	1.5194	1.47	2.0874
.68	.9656	1.08	1.5336	1.48	2.1016
.69	.9798	1.09	1.5478	1.49	2.1158
.70	.9940	1.10	1.5620	1.50	2.1300
.71	1.0082	1.11	1.5762	1.51	2.1442
.72	1.0224	1.12	1.5904	1.52	2.1584
.73	1.0336	1.13	1.6046	1.53	2.1726
.74	1.0508	1.14	1.6188	1.54	2.1868
.75	1.0650	1.15	1.6330	1.55	2.2010
.76	1.0792	1.16	1.6472	1.56	2.2152
.77	1.0934	1.17	1.6614	1.57	2.2294
.78	1.1076	1.18	1.6756	1.58	2.2436
.79	1.1218	1.19	1.6898	1.59	2.2578
.80	1.1360	1.20	1.7040	1.60	2.2720
.81	1.1502	1.21	1.7182	1.61	2.2862
.82	1.1644	1.22	1.7324	1.62	2.3004
.83	1.1786	1.23	1.7466	1.63	2.3146
.84	1.1928	1.24	1.7608	1.64	2.3288
.85	1.2070	1.25	1.7750	1.65	2.3430
.86	1.2212	1.26	1.7892	1.66	2.3572
.87	1.2354	1.27	1.8034	1.67	2.3714
.88	1.2496	1.28	1.8176	1.68	2.3856
.89	1.2638	1.29	1.8318	1.69	2.3998

Potassium Standards (Cont.)

1.70	2.4140	2.10	2.9820	2.50	3.5500
1.71	2.4282	2.11	2.9962	2.51	3.5642
1.72	2.4424	2.12	3.0104	2.52	3.5784
1.73	2.4566	2.13	3.0246	2.53	3.5926
1.74	2.4708	2.14	3.0388	2.54	3.6068
1.75	2.4850	2.15	3.0530	2.55	3.6210
1.76	2.4992	2.16	3.0672	2.56	2.6352
1.77	2.5134	2.17	3.0814	2.57	3.6494
1.78	2.5276	2.18	3.0956	2.58	3.6636
1.79	2.5418	2.19	3.1098	2.59	3.6778
1.80	2.5560	2.20	3.1240	2.60	3.6920
1.81	2.5702	2.21	3.1382	2.61	3.7062
1.82	2.5844	2.22	3.1524	2.62	3.7204
1.83	2.5986	2.23	3.1666	2.63	3.7346
1.84	2.6128	2.24	3.1808	2.64	3.7488
1.85	2.6270	2.25	3.1950	2.65	3.7630
1.86	2.6412	2.26	3.2092	2.66	3.7772
1.87	2.6554	2.27	3.2234	2.67	3.7914
1.88	2.6696	2.28	3.2376	2.68	3.8056
1.89	2.6838	2.29	3.2518	2.69	3.8198
1.90	2.6980	2.30	3.2660	2.70	3.8340
1.91	2.7122	2.31	3.2802	2.71	3.8482
1.92	2.7264	2.32	3.2944	2.72	3.8624
1.93	2.7406	2.33	3.3086	2.73	3.8766
1.94	2.7548	2.34	3.3228	2.74	3.8908
1.95	2.7690	2.35	3.3370	2.75	3.9050
1.96	2.7832	2.36	3.3512	2.76	3.9192
1.97	2.7974	2.37	3.3654	2.77	3.9334
1.98	2.8116	2.38	3.3796	2.78	3.9476
1.99	2.8258	2.39	3.3938	2.79	3.9618
2.00	2.8400	2.40	3.4080	2.80	3.9760
2.01	2.8542	2.41	3.4222	2.81	3.9902
2.02	2.8684	2.42	3.4364	2.82	4.0044
2.03	2.8826	2.43	3.4506	2.83	4.0186
2.04	2.8968	2.44	3.4648	2.84	4.0328
2.05	2.9110	2.45	3.4790	2.85	4.0470
2.06	2.9252	2.46	3.4932	2.86	4.0612
2.07	2.9394	2.47	3.5074	2.87	4.0754
2.08	2.9536	2.48	3.5216	2.88	4.0896
2.09	2.9678	2.49	3.5358	2.89	4.1038

Potassium Standards (Cont.)

2.90	4.1180	3.30	4.6860
2.91	4.1322	3.31	4.7002
2.92	4.1464	3.32	4.7144
2.93	4.1606	3.33	4.7286
2.94	4.1748	3.34	4.7428
2.95	4.1890	3.35	4.7570
2.96	4.2032	3.36	4.7712
2.97	4.2174	3.37	4.7854
2.98	4.2316	3.38	4.7996
2.99	4.2458	3.39	4.8138
3.00	4.2600	3.40	4.8280
3.01	4.2742	3.41	4.8422
3.02	4.2884	3.42	4.8564
3.03	4.3026	3.43	4.8706
3.04	4.3168	3.44	4.8848
3.05	4.3310	3.45	4.8990
3.06	4.3452	3.46	4.9132
3.07	4.3594	3.47	4.9274
3.08	4.3736	3.48	4.9416
3.09	4.3878	3.49	4.9558
3.10	4.4020	3.50	4.9700
3.11	4.4162	3.51	4.9852
3.12	4.4304	3.52	4.9984
3.13	4.4446	3.53	5.0126
3.14	4.4588	3.54	5.0268
3.15	4.4730	3.55	5.0410
3.16	4.4872	3.56	5.0552
3.17	4.5014	3.57	5.0694
3.18	4.5156	3.58	5.0836
3.19	4.5298	3.59	5.0978
3.20	4.5440	3.60	5.1120
3.21	4.5582	3.61	5.1262
3.22	4.5724	3.62	5.1404
3.23	4.5866	3.63	5.1546
3.24	4.6008	3.64	5.1688
3.25	4.6150	3.65	5.1830
3.26	4.6292	3.66	5.1972
3.27	4.6434	3.67	5.2114
3.28	4.6576	3.68	5.2256
3.29	4.6718	3.69	5.2398

SALIVA CHOLESTEROL TEST

1. Measure five (5) c.c. of fresh mixed saliva into a beaker with a pipette.
2. Evaporate to dryness with a fan. Do not use heat.
3. Add 5 c.c. of chloroform and cover with a small evaporating dish. Heat over a water bath 1½ hours. Do not boil the chloroform, but keep just below the boiling point.
4. Carefully transfer the remaining chloroform into a test tube marked for 5 c.c.
5. Rinse the beaker with 1 c.c. chloroform and transfer to the test tube. Repeat until the 5 c.c. mark is reached.
6. Fill one of the 5 c.c. marked test tubes to the mark with cholesterol standard. (0.4 mg. of cholesterol to 5 c.c. chloroform.)
7. Add 2 c.c. acetic anhydride to each test tube—both the standard and samples.
8. Add 0.1 c.c. conc. sulphuric acid to each test tube. Cork and invert several times to mix. (Use rubber stoppers.)
9. Put in the ice box for 15 minutes to allow green color to develop. If it stands too long it becomes yellow and is hard to read.
10. Read on a colorimeter. Usually set the standard at 5. Set it at a lower figure if necessary and correct in the calculation.
11. Calculation:

Reading of Standard ÷ Reading of sample x 8 x 0.01 = mgs. of Cholesterol in 1 c.c. of sample.

Reagents:

Chloroform—Reagent grade.
Acetic Anhydride—Reagent grade.
Concentrated Sulphuric acid.

Standard:

40 mg. of cholesterol, C. P. (Coleman and Bell).
to 500 c.c. Chloroform in volumetric flash.

Normal:

0.0125 mg. of cholesterol in 1 c.c. saliva. Lower cholesterol values are quite acceptable as they indicate an adequate Vitamin A level.

STARCH DIGESTION TEST

1. Place 0.2 c.c. of 5% starch solution in each of 9 test tubes.
2. Place 3 of these tubes in boiling water bath for 5 minutes.
3. When the tubes are almost cool, label and add graduated amounts of saliva—0.1 c.c. to 0.3 c.c.—to the cooked starch in the tubes.
4. To the 6 tubes containing raw starch add graduated amounts of saliva from 0.1 c.c. to 0.6 c.c.
5. Incubate all tubes at 37.5° C. for 5 hours.
6. Read as positive all tubes that have lost all trace of blue color—those that have reached the erythrodextrin stage.

Note: This technique is based on the use of a 9/16 x 5 inch test tube.

This is a modification of the method described by Dr. Anton W. Oelgoetz in the Medical Record for January 1, 1938. cxliii, p. 20.

Reagents:
- 5% Starch Solution:
  - 10 gms. Laundry Starch (Blue Argo).
  - 200 c.c. distilled water.
  - 26 drops Lugol's Solution.

Normals:

Raw Starch	0.3 - recorded as .3.
Cooked Starch:	0.2 - recorded as .2.

Note:

Only fresh Lugol's Solution should be used, as it deteriorates with age at room temperature. It should be discarded if it fails to produce a deep blue-black color in the starch. The average life of Lugol's seems to be about twelve months in the ice box.

Freshly made starch-iodine solution should stand at least three days before using to permit the starch cells to soften. It usually remains good for 30 days in the ice box. Discard at the first sign of deterioration as indicated by a slight loss in the depth of color which should be a deep blue-black.

VITAMIN C (Tillman's)

1. Measure 1 c.c. of saliva and urine into evaporating dishes.

2. To 1 c.c. of saliva add 1 c.c. distilled water. It is not necessary to add the distilled water to the urine.

3. Add 1 drop of Glacial Acetic Acid to each—saliva and urine.

4. Titrate with Dichlorphenol-Indophenol Solution, (1 Hoffman La Roche Tablet to 50 c.c. distilled water) to a faint pink end point which holds ½ minute.

5. Multiply the reading by 0.02. This gives the milligrams of cevitamic acid per c.c. of saliva.

You will find that the saliva usually holds the first end point reached, but the urine usually fades before the ½ minute is up and makes the addition of more indicator necessary.

Lipstick makes the saliva end point reading difficult.

Reagents:

Dichlorphenol-Indophenol (Hoffman LaRoche)
1 tablet to 50 c.c. distilled H_2O.
1 c.c. equals 0.02 mg. Cevitamic acid.

Normals:

Saliva	0.0020 - 0.0026	mgs./c.c.
Urine	0.0075	mgs./c.c.

A high fat assimilation has the effect of reducing the Cevitamic Acid in the saliva and increasing it in the urine.

PHOSPHATASE TEST

(Modified Rowe and Whitmore using Bodansky Unit. Amer. J. Clin. Path., May, 1938)

Use a saliva sample that has stood 24 hours to allow mucus and food residue to settle. Do not shake before measuring.

1. Measure 1 c.c. of the clear liquid to each of 2 test tubes marked for 10 c.c. One tube is for total phosphorus and one for inorganic phosphorus.

2. To the total phosphorus test tube add 5 c.c. of glycerophosphate substrate. (pH 8.6)

3. Heat in a water bath 2 to 5 minutes to bring to the temperature of 37.0° C.

4. Place in an incubator at 37.5° C. for two hours.

5. Keep the tube for inorganic phosphorus in the ice box until incubation period is over.

6. To both the total and inorganic phosphorus tubes add 3 c.c. of Trichloracetic acid 20%.

7. Let stand for 2 minutes.

8. Bring up to the 10 c.c. mark with distilled water.

9. Filter through No. 5 Whatman filter paper.

10. Prepare the standard tube by measuring 3 c.c. of the light phosphorus standard (0.01 mg. per c.c.) into a ten c.c. marked test tube.

11. Place 5 c.c. of the total and inorganic phosphorus filtrates into the original tubes that have been rinsed with distilled water.

12. To each of the three test tubes add the following:
    1 c.c. of molybdate solution.
    1 c.c. of Hydroquinone solution.
    1 c.c. of Sodium Sulphite solution.

13. Bring up to 10 c.c. mark with distilled water.

14. Mix thoroughly with plunger.

15. Allow to stand ½ to 1 hour and read in colorimeter with standard set at 30. Light Phosphorus standard tables can be

used to find mgs. of P in 1 c.c. of each solution. If standard reading is anything but 30, use calculations.

Calculations:

Standard reading ÷ Unknown Reading x .03 x 2=mgs. P/1 c.c.

To find *PHOSPHATASE,* subtract the mgs. of P in the inorganic tube from the mgs. of P in the total phosphorus tube.

The phosphatase unit used is that of Bodansky which is equivalent to 1 mg. of inorganic P liberated from the glycerophosphate substrate in 2 hours at 37.5° C.

Normal:

Plus .002 or less, including all negative values.

Reagents:

Glycerophosphate Substrate:

2.15 gms. of Sodium glycerophosphate.
2.12 gms. of Sodium Diethyl Barbiturate
in 500 c.c. of distilled water.
4 c.c. of 10% NaOH was added to bring the substrate to pH 8.6.
Cover with 3 cms. of Petroleum Ether.

20% Trichloracetic acid.

Molybdate Solution:

A—12.5 gms. Ammonium Molybdate.
150 c.c. distilled water.
B—62.5 c.c. distilled water.
37.5 gms. conc. H_2SO_4.
Add B to A.

Hydroquinone:

0.5 gms. Hydroquinone.
100 c.c. distilled H_2O.
1 drop of conc. H_2SO_4.

Sulphite:

20% Sodium Sulphite (20 gms. anhydrous salt to 180 c.c. distilled H_2O).

Standard: Same as light Phosphorus Standard.
0.010 mg. Phos. in 1 c.c.

ACETONE TEST (Rothera's)

1. Deliver 1 c.c. urine into a test tube.

2. Saturate with ammonium sulphate crystals.

3. Add 1 drop of Sodium Nitroprusside Solution (Rothera's).

4. Add 1 c.c. NH_4OH and shake.

5. Acetone is demonstrated by a color ranging from a pink to a permanganate shade. Record from Trace to four plus.

6. It may take ten minutes for the color to develop.

The presence of URATES is indicated when a reddish straw color is present.

Reagents:

Sodium Nitroprusside—1 gm. to 19 c.c. distilled H_2O.
Ammonium Sulphate—C.P.
Ammonium Hydroxide—full strength.

SUGAR TEST

1. Put ½ inch of Benedict's Qualitative Solution in a pyrex test tube.

2. Add an equal quantity of distilled water.

3. Bring to a boil and agitate constantly to keep from popping.

4. Add 1 c.c. of urine to the test tube.

5. Boil over a flame agitating for one minute.

6. The presence of sugar is indicated by the appearance of a yellow-orange precipitate which makes the solution range from green to orange depending upon the amount of sugar present.

7. Record as a Trace to four plus.

Reagent:

Benedict's Qualitative Solution.

ALBUMEN TEST

1. Fill a large pyrex test tube 1/3 full of urine.

2. Heat the upper ½ inch of urine over a flame until it boils briskly.

3. If a cloudiness appears, add 5 drops of glacial acetic acid. Add the acid in an alkaline urine to test for carbonates.

4. If the upper layer of liquid retains its turbidity after the addition of the acid, there is albumen present. The amount depends upon the degree of turbidity. Record from Trace to four plus.

5. If the upper layer clears up, the turbidity was due to phosphorus being precipitated out by the heat.

6. If gas evolves upon the addition of the acid, it indicates the presence of carbonate.

Reagent:

Glacial Acetic Acid.

STOOL OCCULT BLOOD

1. Spread a small amount of stool on the edge of a paper towel to cover an area of about 1 square inch.

2. Drop 2 - 4 drops of Benzidine Solution on the specimen.

3. Add 2 - 4 drops of Hydrogen peroxide to the specimen.

4. The presence of occult blood is indicated by a blue color which develops.

5. Record from Trace to four plus, depending upon the intensity and the rapidity with which the blue color develops.

Strong color immediately	4 plus.
Strong color delayed	3 plus.
Medium color delayed	2 plus.
Weak color delayed	1 plus.
Presence of very slight color	Trace

Reagents: (To be kept in ice box)

Benzidine Solution:

Benzidine powder in Glacial Acetic Acid. Add a drop or two of water to keep from freezing.

Hydrogen Peroxide.

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